POPULAR SCIENCE

MONTHLY

DECEMBER

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20 CENTS IN CANADA

NOW 15¢

CENTS IN CANADA

NEW INVENTIONS
MECHANICS
THE HOME WORKSHOP
MONEY MAKING IDEAS
350 PICTURES

See Page 31

Forty years ago Eveready introduced the world's first flashlight....

TODAY EVEREADY AGAIN BRINGS YOU A NEW CONCEPTION OF PORTABLE LIGHT

The New Eveready Masterlites

THE TABLE LIGHT

A soft night-light . . . or a bright, searching beam!

Merely lifting the glass dome with the finger-tips turns on a soft, diffused glow. A radium-like lustre makes the dome easy to find in the dark. * * * Pick up the Table Light — and a brilliant, 400-ft. beam of light shoots out from the bottom. The same lamp which lights the dome supplies the spotlight in the base. New, attractive, practical . . . it's the most interesting Christmas gift of the year!

A FLASHLIGHT THAT LOADS LIKE A RIFLE! (*Below*) No detachable parts. Front and rear caps slide out smoothly on chrome runways. Nothing to unscrew....nothing to misplace or lose! To load, you just give the rear cap a slight twist . . . and it springs out on the runways. You insert the batteries just as you do shells in a breech-loading rifle . . . quickly and easily.

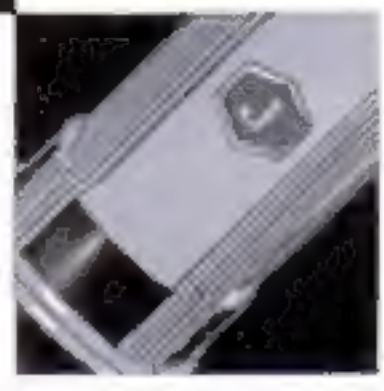
"HAIR-TRIGGER" SWITCH. (*Below*) You just touch the switch and the light is on! Release, and it's off. And instead of pushing a slide switch as you formerly had to do to get a steady, "locked-on" light....you just flick your thumb forward and it's done! The switch is so designed that it can't turn on accidentally.

YOUR OWN INITIAL, RIGHT ON THE CASE! (*Below*) You may replace the trade-mark plate with a handsome black and chrome plate bearing your own initial. A valuable means of identifying your light and a good idea, too, for a *personalized* Christmas gift.

Both of these beautiful new Eveready Masterlites are now on display at your dealer's. Step in and see them today.

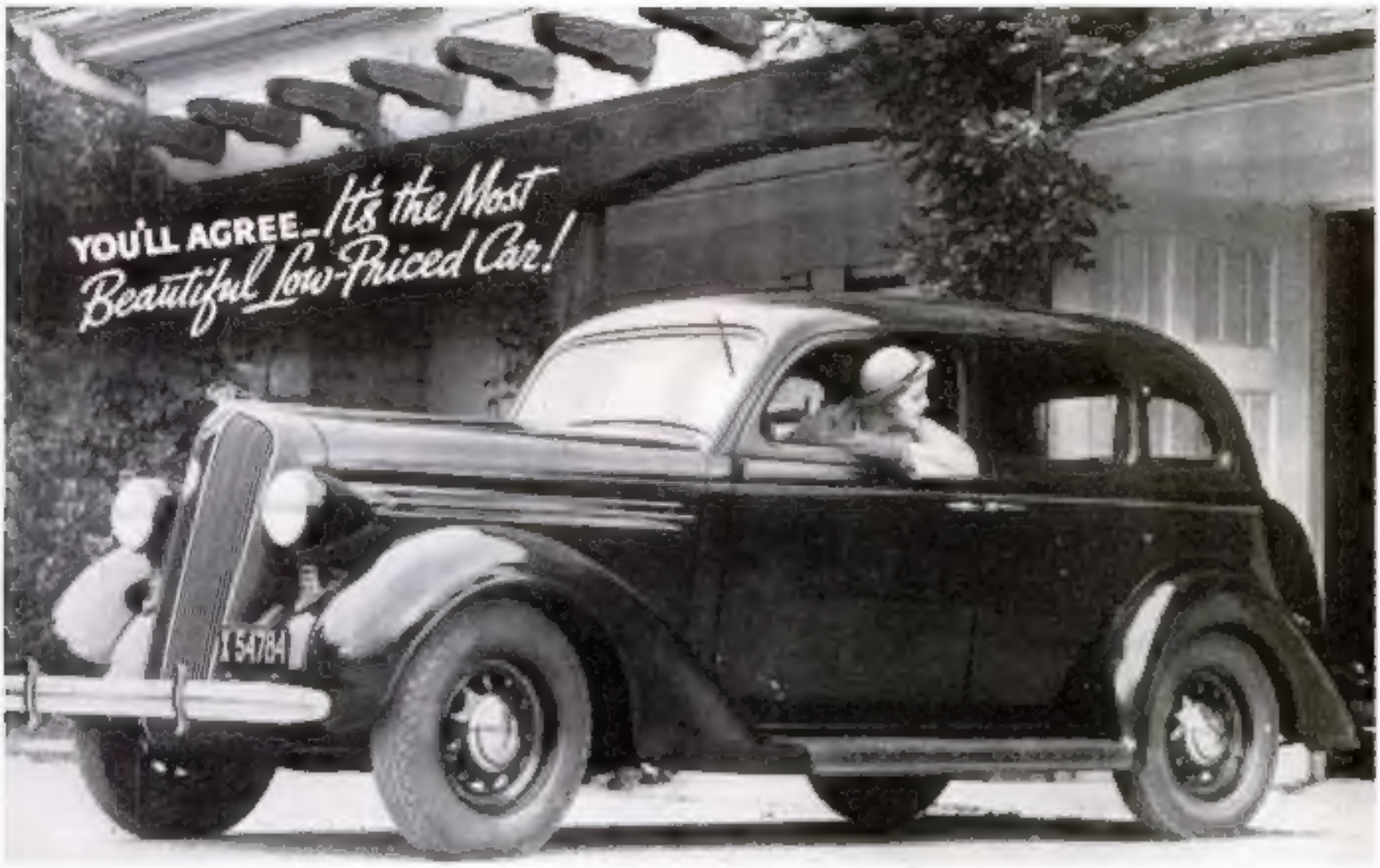
TWO TYPES OF LIGHT AT A TOUCH OF YOUR THUMB! (*Above*) The Light Selector on the new Eveready Masterlite provides instant, one-hand selection of either a piercing "spot" or a broad, diffused beam. For the first time, you can focus the light quickly and easily with one hand *while you hold the beam on the object you want to see!*

"CANDLE-LIGHT" TOP. (*Above*) By just pulling the lens housing out on the runways and rotating the light on end . . . you have a candle-light which illuminates a room yet leaves both hands free for the job in hand. The light can be regulated . . . soft and diffused for use as a night-light, or bright enough to thread a needle!



NATIONAL CARBON COMPANY, INC. *General Offices: New York, N. Y. Branches: Chicago, San Francisco*
Unit of Union Carbide UCC *and Carbon Corporation*

It's the New '36 Plymouth —Now on Display!



40 Improvements—Greatest Plymouth Ever Built!

PEOPLE EXPECTED IT. And now it's here... the greatest Plymouth in eight great years. Forty improvements add to Plymouth's sensational value.

It's the sturdiest car we've built... a 100% more rigid frame... body newly reinforced at five main points.

It is again America's most economical full-size car... with evidence piling up that it gives 18 to 23 miles or more per gallon of gas.

The 1936 Safety-Steel body is not only stronger... and safer... but also has new insulation against rumble and road noise. Plymouth's brakes are 100% *hydraulic*—they stop you safely.

New design steering eliminates the final trace of road-shock at the wheel.

Added to the luxury of Plymouth's Floating Ride are 11 new comfort features... inches more leg room... 2 inches more elbow and shoulder room.

This new 1936 Plymouth is on display at your Chrysler, Dodge or De Soto dealer. See how big and beautiful it is ... drive it. (Ask about the official Chrysler Motors Commercial Credit Plan.)

PLYMOUTH DIVISION OF CHRYSLER CORP.

4 THINGS PEOPLE WANT:

1. **ECONOMY**—All evidence indicates 18 to 23 miles per gallon of gas.
2. **SAFETY**—Plymouth's body is Safety Steel... Brakes are 100% hydraulic.
3. **RELIABILITY**—Of all low-priced cars, Plymouth has most long-life features.
4. **COMFORT**—Plymouth's Floating Ride plus 11 new comfort improvements.

PLYMOUTH BUILDS GREAT CARS

RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, *Home Workshop Editor*
ALDEN P. ARMAGNAC, *Associate Editor*
SYDNEY OXBERRY, *Art Editor*

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FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

H. G. WELLS's Greatest Outline

THE WHOLE AMAZING STORY OF THE SCIENCE OF LIFE

EVERY READER OF THE FAMOUS "OUTLINE OF HISTORY" HAS EAGERLY AWAITED THIS GREAT COMPANION WORK

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TO NEW MEMBERS OF THE LITERARY GUILD

What Wells did for history with such amazing success in "The Outline of History" he has now done for the whole science of life! Here in one thrilling narrative is the dramatic epic of all living things—a whole library of knowledge on every form of life—revealing the mysteries of the human body and human behavior; of animal life; life in the sea; insect life; reptiles and birds; plant life. Here is everything you have always wanted to know about the origin and evolution of all the inhabitants of the universe. In fascinating text and pictures H. G. Wells in collaboration with Julian S. Huxley and G. P. Wells, unfolds the secrets of birth, sex-life, the workings of the body machine in man and in all other living things.

"The Science of Life" is a work which no modern, well-informed person can do without. Originally published in four volumes for $10.00, it is now presented complete in this ONE magnificent volume of 1514 pages—and you may have it free, if you accept this offer of free membership in the Guild. This is the most sensational offer the Guild has ever made. Don't miss it. Act at once before the supply of these wonderful books is exhausted.

1514 Pages

387 Illustrations

A FEW OF THE FASCINATING SUBJECTS IN THIS GREAT VOLUME

How Our Food Becomes Blood
Nervous Mechanism and the Brain
Reproduction and Fertilization
Growth and Development of the Embryo
Childhood, Adolescence, Maturity
Mammals
Birds and Reptiles
Fishes, Insects
Vegetable Life
The Smallest Living Things
Evolution and Creation
Sea Serpents and Living Dinosaurs
"Missing Links" in Evolution
Evidence of the Rocks
Man's Body
How our Cells Multiply
Mendel's Law of Heredity
Is Human Rejuvenation Desirable?
What Determines Sex?
The Ages of Ancient Life
The Plants of the Ancient World
The Reptilian Adventure
Dinosaurs
Wars and Worlds of Life
Life in the Sea
Infections and Contagious Disease
The Six Vitamins
Drugs, Their Uses and Dangers
The Heart and Lungs
Cancer
Tuberculosis
Behavior, Feeling and Thought
Ways of Life Among Ants, Bees
The Amphibian Mind
Courtship in Animals
Play
The World of a Dog
Human Behaviorism
Hypnosis
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AND HUNDREDS MORE

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Outstanding of all advantages of Guild membership, particularly at this time, is the saving in cost of books. Remember, Guild savings are not merely fractional savings. When you can get a $3.00, $4.00 or $5.00 book for only $2.00, you can see at once that your book bills can be cut in half, and that you can afford to buy more books you are most anxious to read this way than under any other plan. A further saving is possible on special book offers of former selections and other titles. Full details of this special plan will be sent to you upon enrollment.

Monthly Literary Magazine "WINGS" Is Free

During the year you will receive without charge 12 issues of "WINGS," a sparkling illustrated little journal with news of books and authors. In this magazine descriptions are given of the Guild's current book selections and recommendations. It is a guide to the best reading and is invaluable to every one who wants to keep up-to-date on the new books.

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The special features of Guild membership guarantee you greater economy, convenience and satisfaction than any other method of book buying. Remember: Members buy only the books they want, and they may accept as few as four books a year. The Guild service starts as soon as you send the coupon. Our present special offer gives you H. G. WELLS'S "THE SCIENCE OF LIFE" absolutely free. This book will come to you at once, together with full information about the Guild Service and special savings.

MAIL THIS COUPON TODAY

FREE—"The Science of Life"

The Literary Guild of America, Dept. 12 P.S.M.
244 Madison Avenue, New York

Enroll me without charge as a member of the Literary Guild of America. I am to receive free each month the Guild Magazine, "WINGS," and all other membership privileges for one year. I agree to purchase at least four books of the 200 to be distributed through the Literary Guild during the year—either Guild selections or otherwise—and you guarantee to protect me against any increase in price of Guild selections during this time. In consideration of this agreement you will send me at once, FREE, a copy of H. G. Wells's "The Science of Life."

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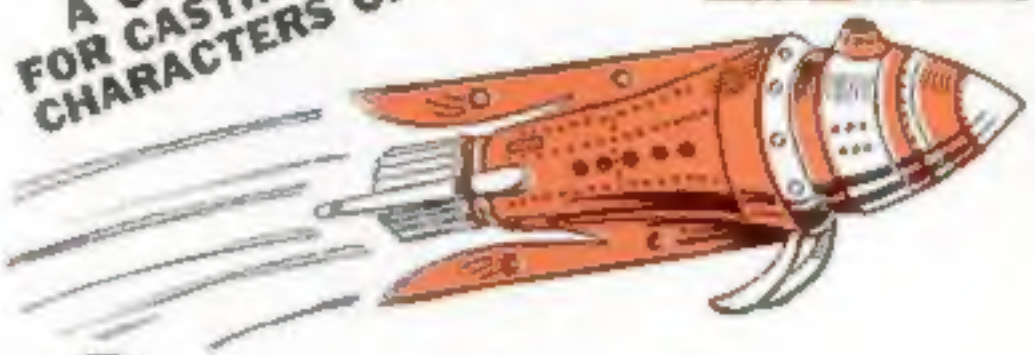
POPULAR SCIENCE MONTHLY FOR DECEMBER, 1935

GUNNERS of the Sixty-second Coast Artillery bringing an anti-aircraft gun into action in the Army war games described on page 16.

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

Buck Rogers 25th CENTURY CASTER

A COMPLETE OUTFIT FOR CASTING & COLORING CHARACTERS OF 2500 A. D.



Fascinating!
Educational!

You Can MAKE MONEY with these Popular Toys

Get this great outfit! Make toy castings of Buck with his marvelous Disintegrator Pistol . . . Wilma Deering, his faithful Lieutenant . . . and Killer Kane, the arch-criminal of the 25th Century. Paint your castings in bright, lifelike colors. Make all the toys you want. Sell them at a big profit! Millions of people are interested in Buck's exploits . . . and follow them daily in newspapers and radio. Start your own toy business with this complete outfit. Make real money.

Buck—Wilma—Killer Kane—3 in One Mould $1.00

A dramatic action group beautifully modeled in the round . . . fully equipped with Rocket Pistols, Disintegrator Rays, Flying Belts. Sizes, Buck, 2-3/4"; Wilma, 2"; Killer Kane, 2½".

Depth Man—Buck Rogers—Dr. Huer—3 Figures in One Mould $1.00

The Weird Depth Man with his ever-ready weapon faces Buck and the famous inventor, Dr. Huer. Vivid, grotesque with Rocket Pistols, Disintegrators, Power Rays and Flying Belts. Sizes, Depth Man, 2½"; Buck, 1½"; Dr. Huer, 1½".

Complete Outfit $2.50

Each Buck Rogers Caster comes in large attractive box with full color cover showing Buck's adventures. Includes complete set of moulds for making 3 big figures: The Weird Depth Man, Buck Rogers himself, and Dr. Huer, the inventor, set with includes mould handles, sluices, a large supply of lead, ladle, 4 cans of paint and 2 brushes.

Buck Rogers Extra Moulds

Strange 25th Century creatures . . . speedy Interplanetary Rocket Ships . . . and friends and enemies of Buck and Wilma. You can make them all with Extra Moulds at $1.00. These large figures in each mould equal the big Buck Rogers Flagship. Complete list in coupon.

You Can Make Over 200 Toys an Hour

It doesn't take long to make enough toys to pay for your Buck Rogers Caster and start saving money.

How to Buy

Buy Buck Rogers Caster at Toy Dealers or Hardware and Department Stores. If they can't supply you, order your choice of outfits on the coupon below. Send postpaid in U. S.

Get 2 Sets in One!

Make U. S. Soldiers with same outfit. Two units like those you have and like 3 figure mould for making armies of soldiers! This gives you 2 sets in one! See coupon.

Jobbers! Dealers!

SEND FOR FREE BOOK

U. S. Soldiers—2½" high

Fill your stocks now!

Buck Rogers Electric Caster $3.50

A Big Large Set with complete Electric Melting Ladle and Stand. Large Size Figures of Buck, Wilma and Killer Kane. Includes complete moulds, sluice, handles, large supply of lead, moulds for smoking missiles, 4 assorted cans of paint, and 2 brushes. Lithographed box in four brilliant colors.

SEND THIS COUPON

Rapaport Bros.
705 W. Ohio St., Chicago

I enclose find Money Order for $ _____
Please send Postpaid in U. S.

OUTFITS
- ☐ Buck Rogers Caster $2.50
- ☐ Buck Rogers Electric Caster $3.50
- ☐ PLEASE SEND FREE BOOK

JUNIOR CASTER MOULDS
- ☐ U. S. Soldiers ..... $ .25

BUCK ROGERS MOULDS
- ☐ Buck—Wilma—Killer Kane $1.00
- ☐ Buck's Own Rocket Ship $1.00
- ☐ Depth Man—Buck—Dr. Huer $1.00
- ☐ Tiger Man—Tiger Ship—Asteroid $1.00
- ☐ Mekkano—One-eyed Man—Interplanetary Ship $1.00
- ☐ Disintegrator—Black Barney—Tanko Man $1.00

Name _____
Address _____
City _____ State _____

Buck Rogers Caster is made by the Makers of

JUNIOR CASTER

This attractive room is paneled with a new fireproof wall board decorated by a new photographic process to look like choice woods

New Ideas *for* Home Owners

FIREPROOF wall board grained to look like choice panels of walnut, douglas fir, knotty pine, and other woods is one of the newest materials for use in home buildings and remodeling. The board, decorated by a special photographic process and protected by a coat of lacquer, needs no additional finishing although wax, shellac, or a second coat of lacquer can be applied if desired. Sold in sections four feet wide and from six to ten feet long, with the same grain, color, and burling in each panel, it lends itself well to decorative matched-grain effects. It will not warp or burn and can be cut either by sawing or scoring with a knife and breaking.

FUSE CAN BE RENEWED INDEFINITELY

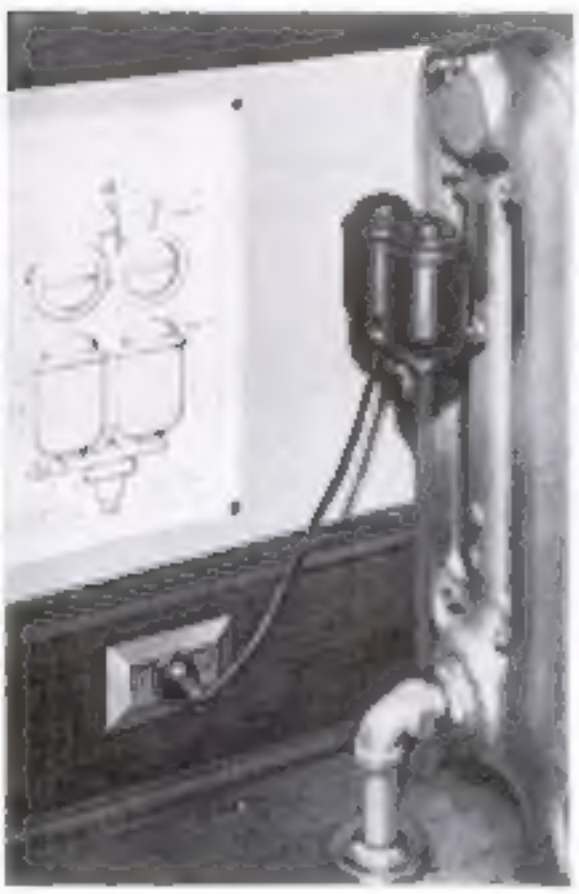
The new type of fuse shown above can be renewed simply by holding it point down and tapping it with a finger. A pool of mercury, instead of the usual fusible alloy, carries the current. According to the manufacturers, these fuses can be renewed indefinitely.

AIR-CONDITIONING UNIT IS EASILY INSTALLED

Costing little more than half the price of an electric ice box, a recently developed air-conditioning unit can be hooked directly into the existing radiator system. In its simplest form the conditioner, which washes, warms, and circulates the air and controls the humidity, is mounted on the basement ceiling and provided with inlet and outlet registers in the floor above. From this point, it is said to be capable of fully conditioning the air in a six-room house. Powered by a small motor, it consumes no more electricity than an ordinary sixty-watt lamp.

ELECTRIC HUMIDIFIER FITS ANY RADIATOR

To PROVIDE automatic control of humidity for small homes during the winter months, an inexpensive electric humidifier has been designed that can be applied to any steam or water radiator. The unit is simply screwed into the plug hole in the radiator and connected to the house lighting system by means of an ordinary lamp cord and plug. Receiving its necessary moisture directly from the radiator, the unit requires no attention once it is installed. In tests by the inventor, the humidity supplied proved to be sufficient for the first floor of the average home. An auxiliary unit makes it possible to use the humidifier for dispensing pine or medicinal vapors.



Questions

FROM HOME OWNERS

Q.—RECENTLY, while replacing the chimney on my home, I accidentally spilled a little of my cement mixture on the asphalt-composition roof. How can I remove the stains that were left when the cement dried?—W.T.M., Syracuse, N. Y.

A.—IF the roof surface is covered with slate granules, remove the stains as completely as possible by scraping the surface and using a wire brush. Then apply prepared cold roofing cement or asphalt roofing paint of the proper color to the damaged surfaces. Finally, when this is tacky, sprinkle on slate granules of the right color. You can obtain these by scraping them from left-over shingles.

Old Electric Meters

R. D. H., MANSFIELD, MO. Under ordinary conditions, neither heat nor humidity will affect the accuracy of an electric meter. *(Continued on page 9)*

TEST Yourself

How many of these questions about automobiles can you answer correctly?

1. How can you make your car ride safer at high speeds?
2. Do modern engines run at higher or lower winter temperatures than the old ones?
3. What should you be careful of when inflating front tires?
4. Why was last winter a severe test of anti-freezes?
5. What is the best way to drive out of deep mud or snow?
6. How can you find out how much anti-freeze your car requires for protection in zero weather?

ANSWERS

1. Have pressure in front tires a few pounds higher than the rear.
2. Modern engines run at much *higher* winter temperatures.
3. Be sure both tires carry the same pressure. Uneven inflation causes shimmy and hard steering.
4. The weather was as changeable as a see-saw. Warm one day . . . cold the next. Ordinary "cheap" anti-freezes boiled away during warm spells and didn't give protection when freezing weather returned. Eveready Prestone won't boil off or evaporate no matter how changeable the weather.
5. *Back* out, if possible. This pulls rear wheels *up* and out. Going forward tends to push wheels in deeper.
6. Find your car on the chart on the inside back cover of this magazine. It shows how little—at the new low price—it will cost to have Eveready Prestone protection in your car.

SPECIAL OFFER...A "Weather Wheel" which will help you to forecast the weather. Also "Weather as a Hobby"—a 48-page illustrated book, prepared by weather experts. Full of fascinating weather facts. Send 10c (stamps or coin) to National Carbon Co., Inc., P. O. Box 600-2H, Grand Central Station, New York, N. Y.

New Construction Kit for a Model of the

GREAT REPUBLIC

FAMOUS AMERICAN CLIPPER SHIP

KIT 4S—Materials for *Great Republic*

CLIPPER ships are more popular than any other type among model makers. The largest and in many respects the most remarkable clipper ship ever built in the United States was the *Great Republic*. Donald McKay, the leading ship builder of his time, constructed her, and in order that he could embody his own ideas without interference from mercenary owners, he built her at his own risk as a magnificent experiment.

Our new construction kit this month contains all the necessary raw materials and full-size blueprints for building a model of the *Great Republic*. The hull is 31½ in. long; the over-all size of the finished model is 42 in. long and 23½ in. high. Not only is it the largest clipper ship model we have offered, but by far the most complete in every detail. The model, if carefully made, is worth more than $100, but the price of the construction kit is only $8.40 (50 cents extra west of the Mississippi River and in Canada).

For convenience, our ship model kits have been divided into three classes. The standard models, of which the *Great Republic* is an example, are the most advanced, although all of them are practical for any one who has an aptitude for this type of work. The simplified models are of the same construction, but very much smaller and easier to make. The hulls are supplied semifinished. Still simpler are our Model-of-the-Month Club kits, most of which are of balsa wood and require few tools beyond a pocketknife, a razor-blade knife, a pair of pliers, and a fret saw.

The complete list of our kits is as follows:

STANDARD SHIP MODEL KITS

A. Whaling Ship *Wanderer*, 20⅝-in....$6.90*
AA. With hull lifts sawed..... 7.40*
D. Spanish galleon, 24-in..... 6.45*
DD. Same with hull blocks shaped.... 6.95*
E. Battleship U.S.S. *Texas*, 3-ft..... 6.95*
EE. Same with hull lifts sawed..... 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 6.75*
GG. Same with hull blocks shaped.... 7.25*
L. Farragut's flagship *Hartford*, a steam-and-sail sloop-of-war, 33⅝-in. hull..... 7.95*
LL. Same with hull lifts sawed..... 8.45*
Q. Privateer *Swallow*, 12½-in. hull, with lifts sawed to shape..... 4.95†
V. Clipper *Sovereign of the Seas*, 20½-in. hull, with lifts sawed to shape..... 4.95†
Y. Trading schooner, 17½-in. hull..... 4.90†

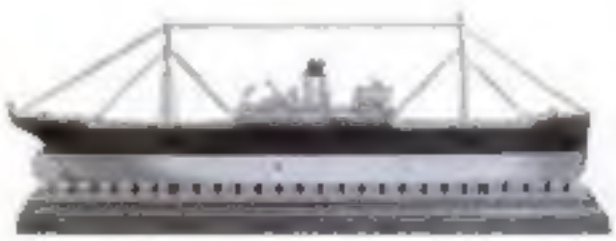
2S. U. S. Destroyer *Preston*, 31½-in. hull, with lifts sawed..... 5.95*
3S. *Constitution* ("Old Ironsides"), 21-in. hull, with lifts sawed..... 6.50*
4S. Clipper *Great Republic*, 31½-in. hull, with lifts sawed..... 8.40*

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan*, 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis*, 12-in. 1.50
J. Clipper ship *Sea Witch*, 13-in..... 1.50

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga*, 18-in..... 1.00
N. Four U.S. destroyers, each 6½-in. .75
O. Liner S. S. *St. Louis*, 11-in..... 1.00
R. U. S. cruiser *Tuscaloosa*, 11¾-in... 1.00
T. U.S.S. *Brooklyn*, armored cruiser in Spanish American War, 8-in..... .75
U. *Hispaniola*, the ship in "Treasure Island," 7-in..... .50
Z. H.M.S. *Bounty*, 11½-in..... 1.50
2M. Show boat, illuminated, 14-in..... 1.50
3M. Ocean freighter, 14-in..... 1.50



KIT 3M—Ocean freighter, 14 in. long

MISCELLANEOUS

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble and stain included..... 5.75*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33⅜ in. high. Ready to assemble and stain included..... 5.75*

No. 7. Whittling kit with two shaped blocks for making sea captain 5⅛ in. high..... 1.50

NOTE: If you live west of the Mississippi River or in Canada, add 50 cents to all prices marked with an asterisk (*) and 25 cents to all prices marked with a dagger (†). Otherwise all prices are postpaid anywhere in the United States or Canada. The kits marked with an asterisk or dagger will be sent C.O.D. in the United States upon request, but the purchaser will have to pay 18 cents additional.

Popular Science Monthly,
353 Fourth Avenue, New York, N. Y.

Please send me Kit.....for which I inclose $.....(or send C. O. D. ☐)

Name .....

Address .....

City..... State.....

(Print name very clearly.)

Remit by money order, check, or registered mail. No kits selling for less than $4.00 can be sent C. O. D. This offer is made only in the United States.

QUESTIONS FROM HOME OWNERS

(Continued from page 7)

As to age, the meter may run slower, if anything, as it grows older.

Nails and "Pennies"

Q.—WHAT does the identification "penny" mean in designating nail sizes? Has it something to do with cost?—T. M Spokane, Wash.

A.—ALTHOUGH it would seem that the dentification "penny" indicates the cost of nails, most authorities trace the term ack to the days in England when nails were sold by the pound. "Penny" indicated the weight in pounds per thousand. One thousand three-penny nails (abbreviated 3d) weighed three pounds, one thousand five-penny nails weighed five pounds, and so on. Now, however, the designation "penny" refers only to length.

Removing Spots on Brick

P S, H., MILWAUKEE, WIS. The white spots that have appeared on the brick walls of your house undoubtedly are caused by efflorescence, an accumulation of salts due to excessive moisture. These spots sometimes can be removed by simply brushing with a stiff wire brush. If this proves unsuccessful, make up a wash consisting of one part muriatic acid and ten parts water, apply this with a stiff wire brush being careful to avoid the mortar joints as far as possible. When the job is completed, neutralize the acid by washing the surface with ammonia solution consisting of one-half pint of ammonia in a gallon of water.

Swelling Laths Crack Plaster

Q.—I RECENTLY had a new plaster wall put in my house to form a partition. In less than a month it developed bad cracks and bulges. What caused them? The plaster was applied over wood lath.—F D Baltimore, Md.

A—CRACKS and bulges in new plaster often are caused by applying the plaster over dry lath. Wood laths must be thoroughly wetted to swell them before plastering. If this is not done, they will swell after the plaster is applied and warp the surface.

Classifying Coal by Size

G Y ST LOUIS, MO. Classified according to size, the various types of hard coal available on the market can be listed as follows: egg, stove, chestnut, pea, and buckwheat, egg being the largest and buckwheat the smallest. Stove and chestnut are most commonly used in the home.

Cutting Slate Shingles

F G. L., PHILADELPHIA, PA. Slate stepping-stones or shingles can be cut by placing the material along the sharp edge of a stone step or a square piece of iron and cutting it with the edge of an old file or hatchet by using short chopping blows.

Our Readers Say

Spares His Fingers And Improves His Deadeyes

WHILE making deadeyes for my ship models, I found it difficult to hold them in my fingers in order to shape them with sandpaper. The result was usually that the deadeyes were uneven and my fingers very sore. To overcome this difficulty I made a little holder for the deadeyes. I took a dowel and drove three small, headless nails (pins with the heads clipped off can be used) into it spacing the nails so that the deadeyes could be slipped on easily. I find this to be a handy idea in model making.—W. L., East Pittsburgh, Pa.

To Cover or Not To Cover —That Is the Question

IN ANSWER to Mrs. L. M. K. of Paterson, N. J., whose letter in reference to seat covers for automobiles appeared in the October issue, I would like to ask: Did you ever notice how dirty seat covers become in a couple of weeks? Wouldn't it be comforting to know that this dirt was not imbedded in the upholstery of your car to come off on your best clothes? And then, why not have artistic covers? I think Mrs. L. M. K.'s reasons for not wanting automobile-seat covers are pretty flimsy.—(Miss) R. E. D., Rochester, Pa.

This Way We'd at Least Earn a Bear Living

I SEE in the newspapers that a fellow out in Wisconsin has cultivated the habit of hibernating every winter like a bear. He turns in along about October, and gets up just in time for Easter. There's an idea for solving the unemployment problem. Teach everybody to hibernate on a staggered plan, so that half the population will be out of circulation all the time, and there will be plenty of jobs to go around. A man would be on either the summer or the winter shift. The bears have the right idea.—P. B., Washington, D. C.

It's Certain To Break In the End

HERE comes another reader with a problem for your army of high-power problem solvers. If equal pull or force is exerted at the ends of a string of uniform strength throughout, where would the string break? Some of my friends say it would come apart all over at the same time, practically disintegrating, others say it wouldn't break at all. This is a problem which, to me at least, seems unsolvable. If it can be solved, I would like to know how.—G.S., Westbourne, Manitoba, Canada.

Germany a Late Convert To Submarines, Reader Tells Us

YOUR recent article on submarines suggests a few rambling observations that may possibly be of interest. I wonder how many realize, for example, that Germany was the last among the great powers to recognize the importance of submarines. The American and French navies were actively developing them long before the turn of the century, and England after keeping aloof for a long time from such a new-fangled idea started building them in 1903. Germany's first submarine was not completed until 1906. It seems a curious turn of fate that Germany became the first to demonstrate their power on a large scale. Whether an aggressive submarine campaign like that of the World War would be as effective today, however, remains to be seen. No longer would it take a country by surprise, as it did in the pre-World War days.—G. H. K., Concord, N. H.

More Support for the Vivisection Movement

I WAS pleased to see the reply of S.Z., Darby, Pa., to the gentleman from Australia in defense of vivisection. Your articles on chemistry and microscopy need only to be supplemented by some articles on zoology and vivisection to satisfy the average amateur scientist. A little consideration of the great part vivisection has and is playing in medical and natural science merits the inclusion of a series of articles on this subject. Surely, I am not the only one that wishes such instructive reading to make possible the study of zoology at home.—J. A. G., Pitcairn, Pa.

Test Detects Blood, If Properly Done, Says Expert

MAY I, as a staff bacteriologist at a state institution, answer R. G. B. of Palo Alto, Calif., and explain more fully the mechanisms involved in legal medical tests for blood? In order to make a presumptive test for blood, whether animal or human, the technician places a small amount of benzidine in a test tube, adds about two centimeters of glacial acetic acid and then hydrogen peroxide equal in amount to the total volume. The sample being tested is placed in this solution and if blood is present a deep blue-green color results. Once the presence of blood is established it is identified by the precipitation test mentioned in the article by William Wolf on poison analysis in the August issue. This is done by immunizing a rabbit to human blood cells until it has a high-titre antihuman serum. A dilution of this serum is placed in a small test tube. It must be properly diluted in order to give a delicate reaction. A drop of the suspected blood immersed in a small amount of physiological salt solution, is dropped on the surface of the immune serum. It is saturated about fifteen minutes at thirty seven and a half degrees C. and if the blood is human, a fine, white ring appears where the antiserum and blood solution meet. This test works for both sides, being the most delicate known for proteins.—V. S., Glen Lake, Minn.

Wants Universal Language For Radio Listeners

TWENTY years from now, I believe, all schoolchildren are going to be taught two languages — one their native tongue, the other an international language used for world-wide radio hook-ups. Recent broadcasts from abroad have emphasized the need for a common tongue we all can understand. Anyhow, that's my prophecy for the future. What is yours? Unlimber your imagination and let's hear in Our Readers Say what you think the world will be like in 1955.—F. A., Toledo, O.

It Undoubtedly Would Be A Flying Start

I WOULD like to call your attention to the fact that the cruising range of seaplanes could be greatly increased if a tug plane were used to tow and to give added power to a seaplane during its take-off and to continue, in towing position, to augment the plane's power during the initial stage of its flight. In this manner, the fuel load of the seaplane could be greatly increased and consequently its cruising range extended. With this arrangement the type of planes recently built for transpacific service could be run on a more profitable New York-to-Europe route. Similarly, the range of rockets could be greatly increased if an elevator plane were used to lift the rocket into the stratosphere and there launch it at high speed so that large and hampering wings could be replaced with smaller and more effective ones.—P. E. P., Hamden, Conn.

It Always Comes Down To Mud and Cooties

SOMEHOW or other, I can't take much stock in all this talk about tanks and new weapons eliminating trench warfare. Modern defense and attack are too well balanced. We build heavily armored tanks and then turn around and construct a gun whose bullet will pierce the heaviest armor. On one hand, we design fast pursuit planes and giant bombers and on the other we perfect rapid-fire mechanically aimed antiaircraft guns to bring them down. One group of chem-

ists discovers a new deadly gas and another group compounds a gas-mask reagent to counteract it. To my way of thinking, the next big war will be as much of a trench stalemate as the last and it'll be the old-fashioned rifle-carrying soldiers who'll take the brunt of it, do most of the fighting, and decide the outcome.—P C S., Akron, O

A Pointed Suggestion From a Fencing Fan

I THINK that J H. of Brooklyn, N Y., had the right idea when he said that there should be a few articles on the art of fencing. Many of the well-known schools and colleges throughout the country teach fencing as a desirable recreation, so why not have a few snappy, illustrated articles on this sport? In addition to describing and illustrating the art of fencing, you could tell us how to make our own foils, masks, and other equipment.—D H S., Philadelphia, Pa.

Visions Light Images Fading Into One Grand Blur

THE idea of "light waves as an outward-rushing panorama of life as it transpired," offered by A.E. of Ann Arbor, Mich., is not new but it is interesting to hear of it again. Do you really believe light waves can perpetuate in space the image of life on this earth? Tell me then why miles and miles of atmosphere composed of air levels of varied densities, shifting clouds, and blown particles of matter, wouldn't refract, absorb, and reflect the light waves in such a manner as to take from them their individual characteristics and leave them as bars of light? Maybe I'm wrong but it seems to me that such a panorama of life in light waves would soon be blotted out.—A P Youngstown, Ohio

These Wind-Power Propellers Would Be at Odds

RECENTLY I have been reading articles about the generators at Niagara Falls. They state that the field coils in these generators revolve around the armatures. I was wondering if it would be of any advantage to design a generator with the armature revolving one way and the field revolving in the opposite direction. My thought was that a generator of this type would be good for wind-electric power work. One propeller could be designed to go clockwise and another could turn counterclockwise and a collector ring could be used on the positive side.—F B., Crane Valley, Saskatchewan, Canada

Microscopist Identifies Those Self-Anchoring Protozoa

REGARDING the recent question of H D M of Peru, Ind., about the large, slime-attached protozoa he saw through his microscope, I believe they were either Stentors or ciliate Vorticella. Both of these organisms belong to the infusorian group and have bell-shaped bodies supported on slender, contractile stems, which H D M. has described as tails. Now I have a question. How about some problems for the chess fans? I'm sure there must be a lot of them among your readers.—V.S.H., Jerseyville, Ill.

Why Look at Penguins When People Are So Funny?

THE letter of H W., Scranton, Pa., about the penguin's strange habit of climbing up icebergs just for the fun of scooting down again, reminded me of a funny thing I saw in New York City the other day. I was starting down the long stairway that leads to the Long Island Railway station, alongside which there is an escalator for the use of people coming up. Just as I reached the head of the stairs, I saw a young woman step off the escalator at the top, turn around, and start walking back down the stairs. It seemed strange, but I assumed that she had forgotten something or perhaps changed her mind about where she wanted to go. Imagine my surprise when, reaching the bottom of the stairs, she promptly got back on the escalator and rode up smiling happily. At the risk of missing my train, I stopped to watch, and saw her repeat the performance three times. For all I know, she's there still. If H W. thinks that penguins are funny, he ought to pay some attention to the human race.—B A., Flushing, N Y.

P. S. M.'s Crowd Him Out But He Looks for More

EVER since 1930, I've been reading POPULAR SCIENCE MONTHLY and I have every issue. I file them in a large filing cabinet because of the help they give me. I also have 2,000 filing cards covering articles which have appeared. If the magazine keeps up as good as it's going now, I'll have to rent a house for my files. As an amateur detective, I find your stories on crime very helpful. Let's have more of them. Also why not include, from time to time, articles on analytical and organic chemistry, bacteriology, astronomy, toxicology, and plans for building high-frequency electrical apparatus. If you do, I'll need that extra house.—J O.S. Jr., Middle Village, N Y.

His Accidental Radio Hook-Up Has Him Going

EXPERIMENTING with a photoelectrical cell, I hooked up a neon lamp to the output of a radio set and projected the light on the cell. Then I connected a pair of earphones to the cell output and listened. I got no results, so I grasped the neon tube to move it closer to the cell and instantly I heard a man talking. Without thinking, I moved my hand away from the cell but the talking continued. I disconnected the cell and then I disconnected the earphones. With the disconnected earphones still on my head, I heard music whenever I touched the flickering neon tube. The volume of the sound increased as I put more of my hand on the tube until it reached an amplitude comparable to the output of a crystal set. Upon removing the phones, I could hear nothing. Probably some reader can give me an explanation for this action.—W F Jersey City, N. J.

Step Into My Parlor, Says One Spider to Another

SOMETHING is taking place in my shop window now that is contradictory to all precedent about which I have heard. A large grass spider has taken possession of the whole window ledge and I, being spiderly minded, have let it stay. The web has changed hands several times and now two spiders are living there together. One, apparently the visitor, appeared starved when it first arrived but now it is putting on weight. The two don't seem to pay much attention to each other. Maybe if I keep them well stocked with flies, they'll get along serenely. I want to thank J C F. Zanesville, Ohio, for his hints on typewriter repairing. They enabled me to remedy my "hunt and punchers" worst ailments except spelling.—D.H., Santa Monica, Calif.

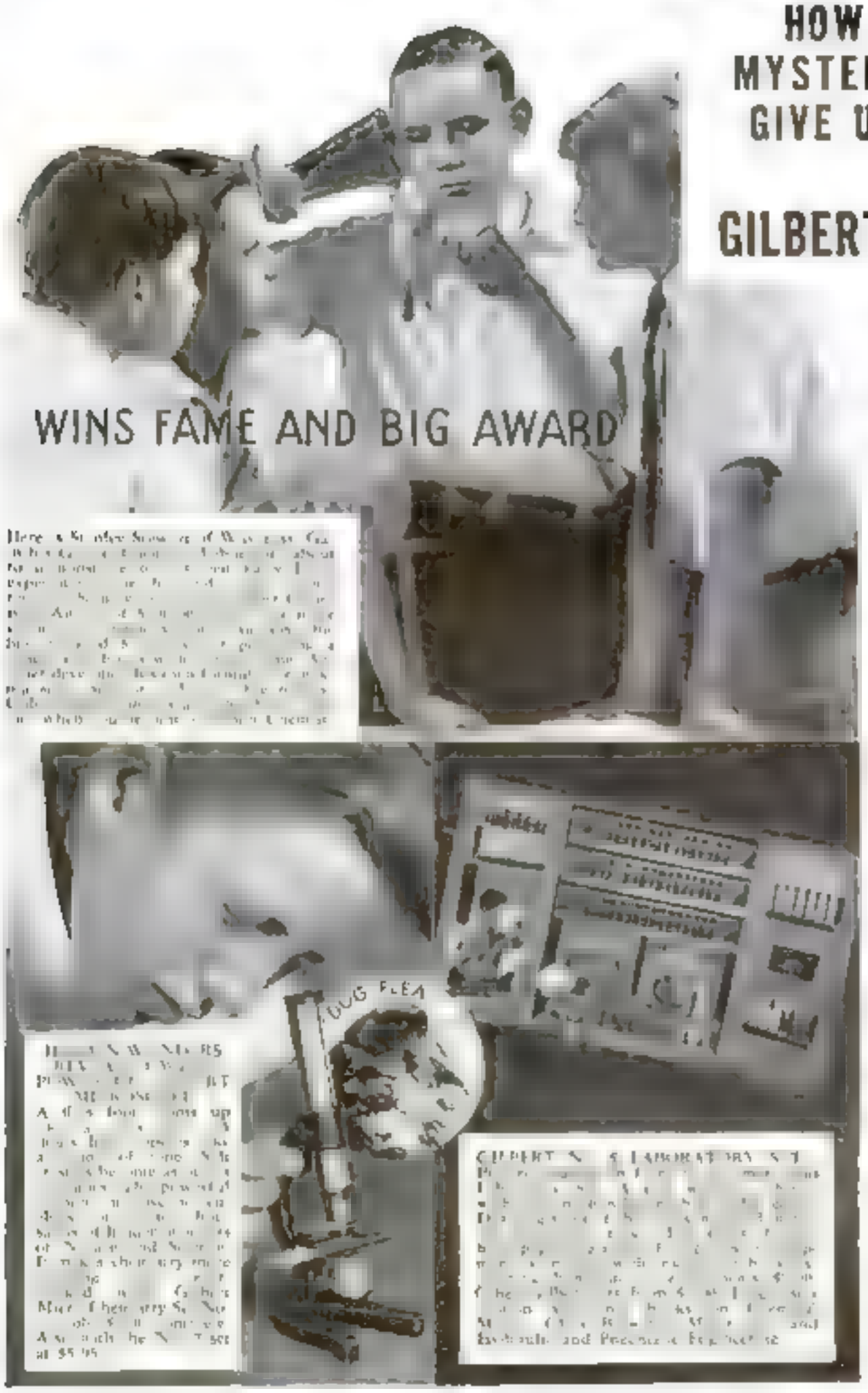
Marionettes Seem To Offer A Test of Versatility

WITH reference to the interesting article on marionettes in the September issue, I would be interested in seeing more articles on marionettes and puppet theaters. There are so many hobbies that enter into the construction of puppet theaters that I have thought for some time a department in your magazine would be profitable to many readers. In the construction of the stage and sets there is an opportunity for the exercise of woodworking skill. The lighting equipment and stage machinery should appeal to those interested in electricity as it involves the development of trick switches and motors, the use of remote relay controls, and all kinds of fancy wiring circuits. For the radio enthusiast, the stage can be wired for sound. For the modeler and designer, there is a wide field in the making of the puppets themselves. My stage measures eight by four feet, the proscenium eight by seven feet, and the proscenium opening six by three feet. The scale used throughout is two inches to the foot. The border and foot lights are wired for four colors, controlled from a central switchboard. The ground rows and cyclorama are illuminated by neon tubes some six feet in length. The sound equipment includes remote-controlled radio and repeating phonograph, the output of which is amplified through two separate amplifiers—one handling frequencies above 1,000 cycles, the other below 1,000 cycles. The outputs of the amplifiers are fed into their respective speakers behind the stage. The output of both speakers is about fifteen watts and, by having separate amplifiers for the bass and treble, the music can be adapted to the occasion.—J B M., Merrick, N. Y.

Opportunity Knocks At the Hobbyist's Door

THAT a needed invention or a new process may result as a by-product of a hobby was impressed on my mind recently when I read that an eminent scientist whose hobby is painting, developed three pigments which, with the addition of white, meet every color requirement of the artist. The scientist is Dr Herbert E Ives, a physicist who specializes in the field of optics. Dr Ives, it is stated, was troubled by the numerous tubes of paint he had to use in his art work. So he decided to do something about it. The result was the perfection of three pigments which he calls minus red, minus green, and minus blue. Each of these reflects mainly the light rays complementary to its "minus" hue but each also reflects a range of other colors. By mixing them, any shade of color can be obtained and by combining all three, black is produced. A white pigment is added to obtain tints. Dr Ives now works with only four colors on his palette! This achievement, it seems to me should be an encouragement and an incentive to all of us who are hobby riders.—F O F. Newark, N J.

GILBERT BOY CHEMISTS LEAD IN THRILLING SCIENTIFIC DISCOVERIES



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POPULAR SCIENCE Monthly

DECEMBER 1935 VOL. 127 No. 6

RAYMOND J. BROWN, *Editor*

CAN YOU *Prove* WHO YOU ARE

By JOHN E. LODGE

A pattern of eyeball veins as registered by the microscopic camera. No two patterns are the same

Both the U. S. Department of Justice and the New York police are reported to

Science Finds New Telltale Marks of Identity

In many hospitals the footprints of new-born babies are recorded before they leave the delivery room. This is done to remove any danger of substitution

Babies are sometimes branded with ultra-violet rays passed through a stenciled number

be testing the new aid to identification. Because the veins of the eye cannot be altered—as can a criminal's face by surgery or his finger tips by the use of acid—eye-prints may prove vital to cornering big-time outlaws. Once again the laboratory has come to the aid of the criminologist.

In fact, few phases of criminology depend so much upon science as does the work of identification. Time and again, in murders, kidnapings, amnesia cases, and fake suicides, the scientific sleuth must open his bag of tricks and prove an identity.

A few weeks ago, an elderly man was found a suicide in a hotel in an eastern city. Before he shot himself, he had tried to destroy every means of identification. There were no marks on his clothing; no letters or cards on his person. His registered name and address were false. Only one thing he had overlooked—his spectacles.

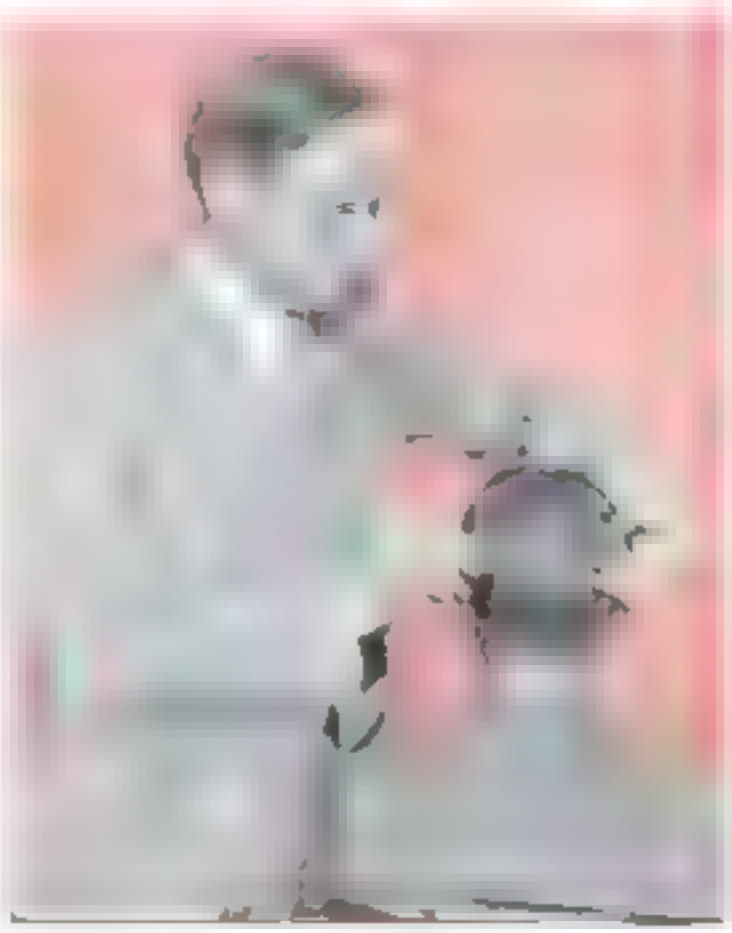
Although these were broken, detectives traced them back to the factory where they were made. It proved to be an organization with a dozen branch stores selling tens of thousands of spectacles a year. However one of the experts there made careful measurements of a fragment of the glass and was able to determine the prescription of the lens. With this clew, the detectives ran through the list of elderly men who had purchased glasses of that particular kind and ended by solving the apparently hopeless case and establishing the identity of the unknown.

Even such tiny clews as almost invisible scratches on metal help the sleuths of a missing persons bureau. A dozen times, in recent years, the silent testimony of such scratches has turned a search in the right direction.

Early one morning this fall, bargemen were working their way slowly through a fog on the East River at New York City. Just above the Brooklyn Bridge, one of the men sighted the nude body of a middle-aged man floating in the water. He had been shot through the head and every shred of clothing which might have given a clew to his identity, had been stripped from his body by the murderer. On one swollen finger, however, detectives discovered a plain gold ring.

Frequently, large jewelry houses mark all the goods they sell by putting a tiny scratch in a secret place. It protects them against substitution in the case of returned goods. In this instance, a prominent Fifth Avenue jeweler identified the ring through such a scratch, checked back and found the name and address of the purchaser, and thus enabled detectives to take up the trail of the slayer with a minimum loss of time.

In other cases, scratches left by repairmen on the insides of watches have established identity. Lodge pins and fraternal insignia frequently help. Handwriting, hair, and the fibers of cloth, under scientific scrutiny, often reveal clews. And, so important are laundry marks that the Missing Persons Bureau in New York City maintains a file which includes thousands of them.



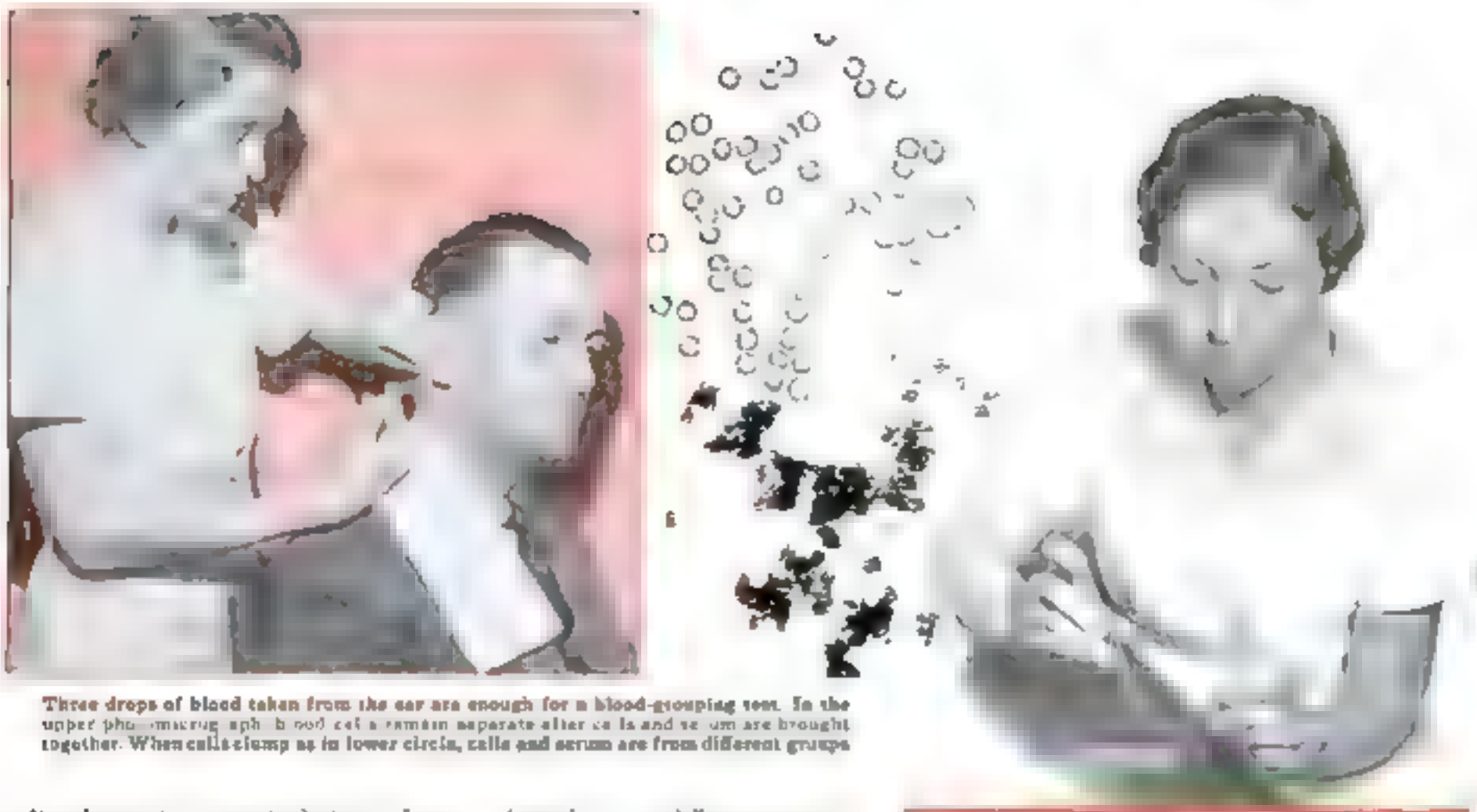
Dr. Paul Popenoe, director of the Institute of Family Relations, measuring a hair whorl with a protractor. Hair whorls are inherited and help to prove a person's identity

In addition to these outside aids, the scientific detective depends upon subtle differences in physiology—telltale characteristics that make us individuals. The further research plumbs the mysteries of the human body, the more it finds to aid the expert in identification.

Take, for instance, the discovery which won the Nobel Prize in 1930 for Dr. Karl Landsteiner, the Viennese blood expert at the Rockefeller Institute in New York City.

Landsteiner found that when he mixed red blood cells from one individual with the serum, or clear part, of the blood of another person, a strange reaction often took place. The cells would clump or collect together in bunches. This is known as agglutination and is caused by antibodies in the serum acting upon a substance in the cells. From this discovery came the classifying of bloods into four types and a simple test for finding in which type anyone's blood belongs.

Recently, I visited a laboratory at the Pasadena, Calif., Hospital to learn at first hand how the test is made. A nurse jabbed a spring-operated needle into the lobe of my right ear and collected three drops of blood. Next, she mixed the blood with a



Three drops of blood taken from the ear are enough for a blood-grouping test. In the upper photomicrograph blood cells remain separate after cells and serum are brought together. When cells clump as in lower circle, cells and serum are from different groups

salt solution to prevent clotting. A moment later, she placed tiny droplets of my blood on a glass slide containing in little puddles three types of serum.

As I watched tiny clumpings resembling cayenne pepper began to appear within two of the circles. In the third circle nothing happened. This meant that my blood belonged to the group represented by the third serum and not to either of the others in which the clumps appeared. Only three serums are needed for a test. If all three produce clumps, the expert knows the blood belongs to the fourth group.

How this test often plays a dramatic role in police identification work is illustrated by a western murder case

THE victim was found stabbed to death, and a former friend was accused of the crime. He admitted knowing the victim. He admitted having been in the vicinity at the time of the murder. He admitted stains found on his clothing were caused by human blood. He admitted a carving knife, discovered in his house stained with blood, was his. There seemed no question of his guilt.

The accused man's story was that he had cut his finger while carving meat and the stains on the knife and his clothing had come from his own hand. Few people believed him and but for Dr Landsteiner's discovery, he probably would have gone to the electric chair.

However, when experts in the laboratory examined the stains they found they were produced by group-B blood, the same as that found in the veins of the prisoner. The dead man, on the other hand, had an entirely different type of blood. Thus, in a simple test that took but a few minutes, science gave an innocent man his freedom.

Recently, the Landsteiner test has been employed frequently in court to test disputed parentage. In nearly a third of the cases it has shown that men who were accused of being fathers of illegitimate children could not have been, because their blood and the blood of the children belonged to two different groups.

The most unusual instance in which the test was called upon to prove parentage occurred in the Middle West.

A wet-nurse was suspected of having substituted her own child for the baby that had been intrusted to her care. The mother demanded a blood test. This laboratory experiment revealed that the baby then in the house could not belong to the supposed parents. The nurse then confessed and returned the right child.

Although this scientific basis for blood testing is a product of recent years, experiments based on superstition have been known for centuries. In Japan, for instance, when persons used to claim relationship, blood was taken from the arteries of both and dropped into water. If the blood flowed together, it was thought to indicate they were, in fact, related. Again, if an attempt were being made to prove relationship with some one deceased, a drop of blood from the claimant was placed on a bone of the skeleton. If it penetrated the bone and could not be washed off, the claim was considered proved.

Recently a report from Germany told of an entirely new method of distinguishing between different types of blood. Prof W Zangemeister, of the University Gynecological Clinic at Koenigsberg, has developed the delicate electrical apparatus used in the work. It shoots a cone of light through an opalescent glass and a test tube filled with blood serum. On the other side, a sensitive photometer compares the amount of illumination coming through the glass with that coming through the serum, which varies according to the size and number of the albumen particles it contains. Thus, the dial readings of his photometer instantly distinguish between bloods that belong to different people.

Dr Popenoe determining the true color of a man's eyes by comparing them with a chart on which forty different eye colors are shown, ranging from albino to the darkest brown

Another scientific discovery, which promises to find an important place in the work of identification, relates to human finger nails.

When finger nails are coated with a light transparent oil, tiny capillaries in them appear through a microscope as commas. Differences in their form and general pattern give a key to identity. By means of such a test, even identical twins can be told apart, although in such cases the comma patterns are strikingly alike. In cases of ordinary twins, these patterns vary considerably in arrangement. The balls and curved tails of their formations differ both in number and in size.

Of course, the ace aid to identification at the present time is the fingerprint. It has been adopted throughout the world. Palm prints and footprints are likewise being used. In (Continued on page 118)

Make-Believe Battles

TEST UNCLE SAM'S WAR MACHINE

American doughboys go over the top. These are members of a New York National Guard unit taking part in the mammoth military maneuvers at Pine Camp, N. Y., in which a (theoretical) problem in national defense was presented and solved

By
Robert E. Martin

PORING over field maps and checking voluminous reports from high commanding officers, the United States Army's "brain trust"—the General Staff at Washington, D. C.—is still analyzing the results of its latest mimic war. The maneuvers were the greatest ever held during peacetime in American history. More than 56,000 men in olive drab clashed in mock battle at Pine Camp, N. Y., Fort Devens, Mass.; Mt. Gretna, Pa.; and Virginia Beach, Va. During the last two weeks in August they marched, bivouacked, skirmished, and charged, firing a total of 500,000 cartridges.

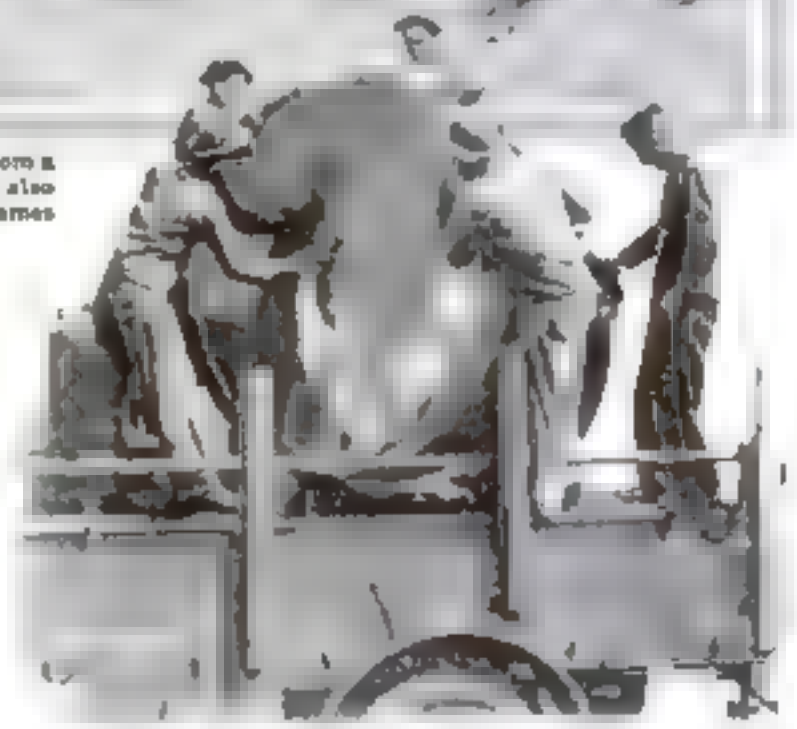
Abroad, too, war games made front-page news last summer and fall. Russian and Italian troops maneuvered on a vast scale. France, Germany, and England had smaller but important war games. Danish and Austrian armies fought mock engagements. Navies—British, Italian, Japanese, American—carried out "problems" with great armadas. The world has been seeing more and bigger army and naval maneuvers than since 1918.

What is their purpose?

Fighting wars is probably the only science, art, or profession where the training is so largely theoretical. A doctor attends real patients, a lawyer tries real cases—but a soldier fights few, if any, real wars. Yet when he does fight he must win, or his country is lost. When he has crawled on his stomach through thickets and brambles against a mimic "enemy"—when he has taken "prisoners" at bayonet point or fallen a "casualty" from enemy fire—he is better trained to take care of himself if a real war should come along.

There is another excellent reason for staging war games—the development and testing of plans for national defense. On the sea, ma-

"Casualties" being evacuated from a field hospital. Medical units also gain experience in the army war games



Members of the Sixty-second Coast Artillery polishing the eye of one of their giant searchlights for use against aircraft

neuvers reveal whether a given coast line can be effectively defended, and if so, how; whether we should build more big battleships, or concentrate on smaller and swifter craft. On land, they show what cities are vulnerable to attack and where to dispose troops and guns to protect them.

To be more specific, suppose that a hostile power or coalition of powers should launch a surprise attack through Canada on northern New York. Notice that we're just supposing; we hope it won't happen, and no one expects that it will. But it is the duty of the Army to be prepared for the unexpected. Would its General Staff be able to produce a plan, already worked out in every detail and ready for instant execution, to speed troops to the most effective strategic points to defend the country? When a menacing "Blue" army—actually consisting of two divisions of the U. S. National Guard—swept down upon a defending "Red" army of regulars in upper New York State last August, it was testing the very situation mentioned in these suppositions.

From lessons learned in its war game the Army high command several years ago worked out what it considers to be the best plan of defending the United States as a whole, with the 165,000 regulars, 180,000 National Guardsmen, and 100,000 reserve officers at its disposal. It has divided the men into four separate field armies, guarding, respectively, the North Atlantic region and northeastern frontier, the Great Lakes area and the central northern frontier; the Gulf of Mexico region and the Mexican border; and the Pacific coast. Real war would be a different problem in each of the four field army areas, so four war games are held, one each year; this year's was the first in the First Army area, which contains 40,000,000 people and is protected by upward of 100,000 troops.

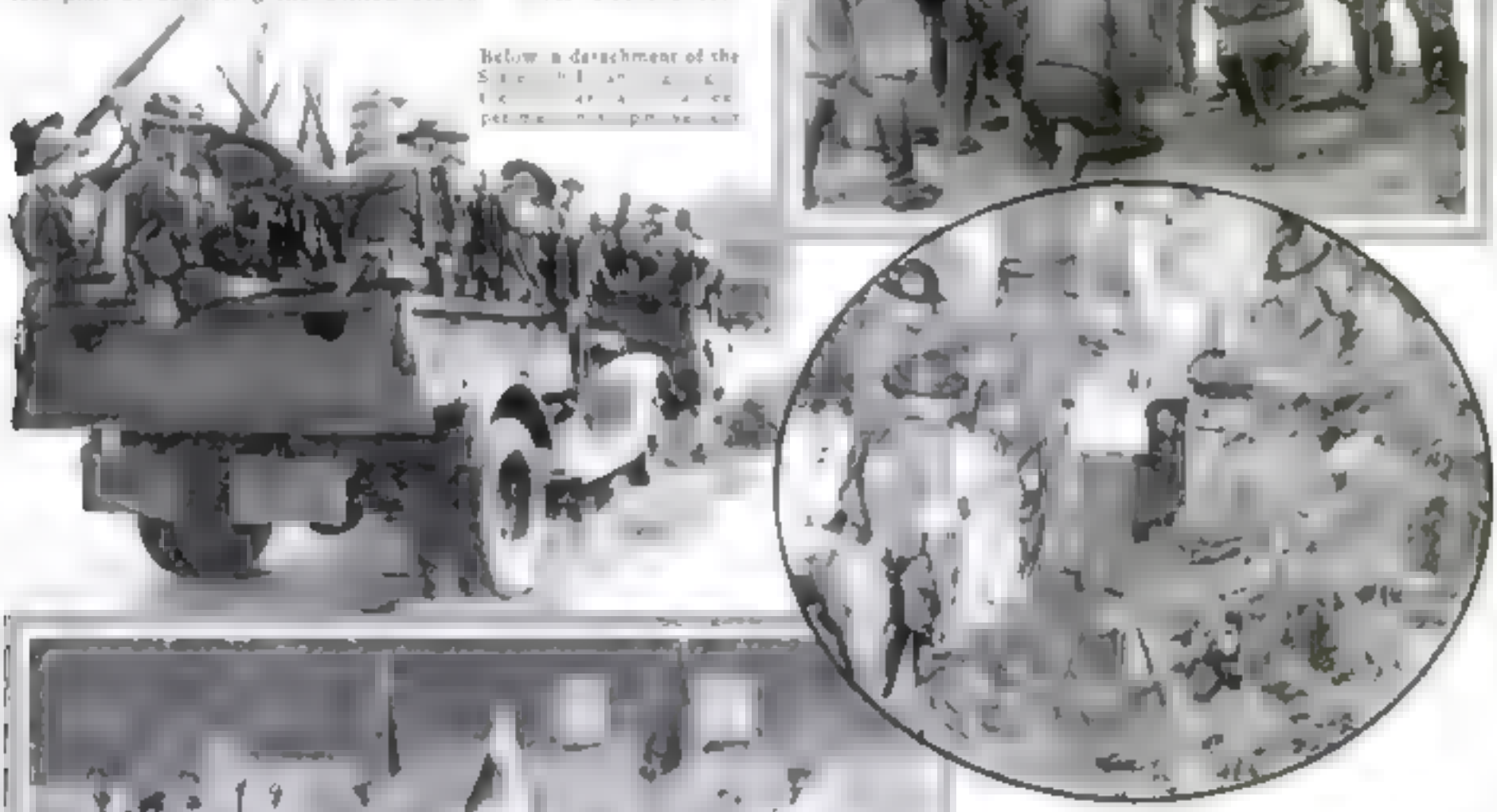
To the observer within a mimic war zone, it all seems real indeed. Dusty columns of troops march past and staff cars whiz by on the way to the front [illegible] artillery. Stretcher bearers [illegible] ing bandaged doughboys. But the cartridges are blanks. The grinning "casualties" are unharmed, for all their display of tape and surgical gauze. How can any one decide which side won?

That is the duty of the umpires—scores of alert observers, wearing conspicuous white batbands and carrying code flags to signal their decisions. As the soldiers are ordered into action and leap from their trenches—which often are simply strips of ground designated by zigzag lines of white tape, to economize time and money—an "area umpire" in charge of 500 yards of front watches to see which of the opposing troops are handled most skillfully and act most effectively. Then, swinging a red or a blue flag, he indicates which side is permitted to advance and how much ground it has gained. Individual soldiers who expose themselves carelessly are likely to have a keen-eyed umpire spot them and put them out of action as "casualties"—marking them with white tags and sending them to the rear—or perhaps to dressing stations where members of medical units practice bandaging their supposed wounds.

Even the movements of supporting troops some distance from the front are controlled by umpires, according to the probable effectiveness of hostile fire. This need not be guesswork. In the recent Pine Camp ma- *(Continued on page 121)*

These are the men who decide the fortunes of war. A group of umpires using field telephones to compare notes with others elsewhere in the field

Below, a detachment of the [illegible]

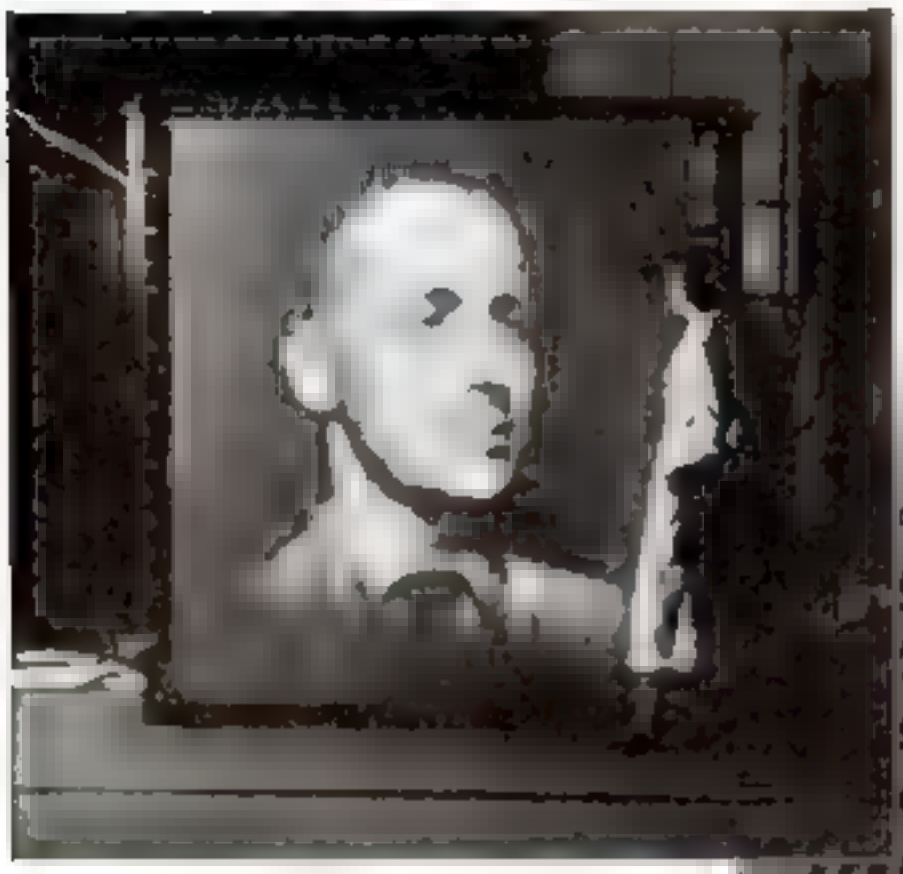


SOME OF THE UMPIRES WHO CALLED THE PLAYS IN WAR GAME
Umpires in conference during the war games. Identified by conspicuous white batbands, they watched each move in the "war" and signaled their decisions with flags like those seen here

The Signal Corps in action establishing com[illegible]

Blinking Lights Form Television Screen

Simple New System Developed in Germany Can Be Used in Theaters and Auditoriums



PRACTICAL [illegible] by means of [illegible] box like cells, forming a square picture area six and one half feet on a side. When a scene at the transmitting studio is scanned in the usual way, the brightness or darkness of each portion is translated into electron impulses transmitted to receiving apparatus, and reproduced upon the new screen in a pattern of lighted and unlit lamps. By reproducing a series of images in rapid succession, the screen presents an animated "movie" of the subject. In this way engineers forecast theater patrons may be enabled to witness far away news events while they are happening. Another application [illegible] capacity to be seen as well as heard by overflow audiences elsewhere, supplementing the loudspeakers of a public-address system. The crisscross streaks resulting from the design of the screen, while objectionably noticeable at close range, are said to fade from view at a distance.

PHONOGRAPH DISKS MAKE RADIO SOUND EFFECTS

SOUND EFFECTS are produced with phonograph records, instead of with elaborate mechanical devices, in the latest technique employed in radio broadcasting. Each record carries several sound tracks, which are separated by blank channels and identified by number; No. 1 may be a pistol shot, No. 10 a railroad train, and so on. When the pick-up arm of an electric phonograph has been preset by moving it until a graduated dial shows the corresponding number as illustrated above, the desired sound effect is instantly produced by pressing a button.

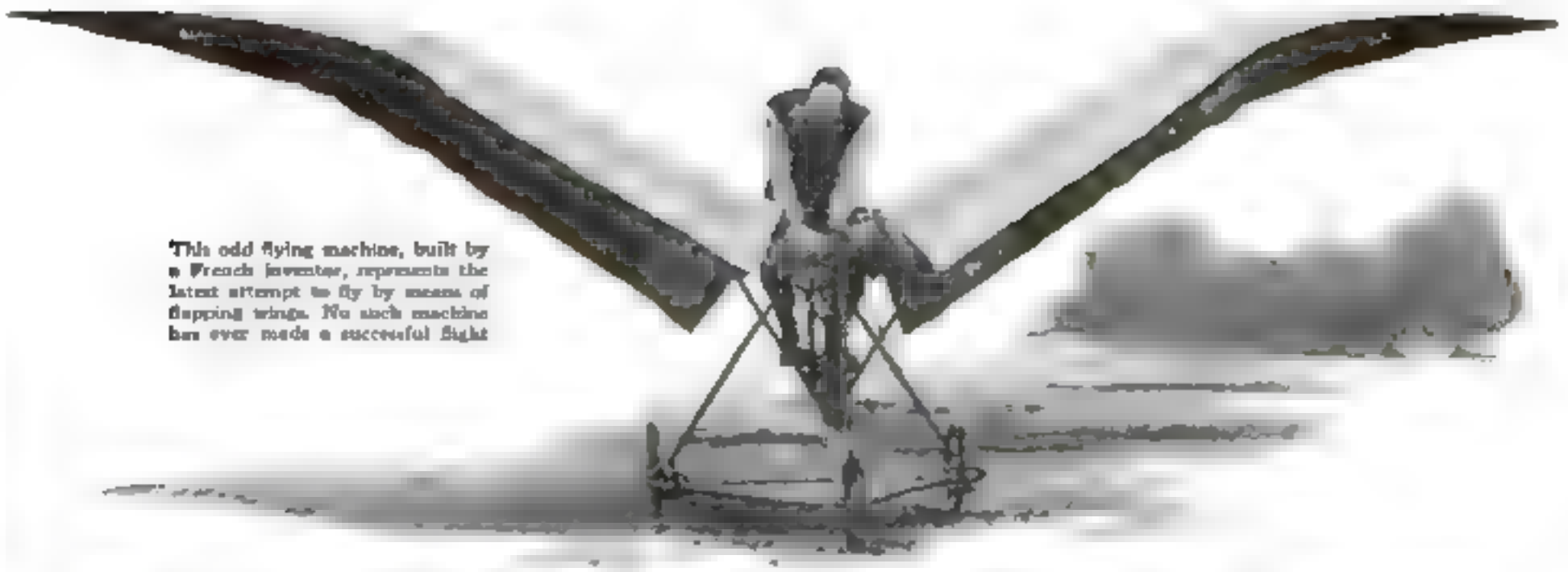
EXPLORERS TO ENTER JUNGLE IN ODD AMPHIBIAN TANK

Strange land-and-water craft in which explorers will penetrate dense South American jungles with safety

MANNED by a crew of three, an amphibian boat resembling a war tank may soon invade South American jungles on a journey of exploration. The odd craft, recently tested at Mineola, N. Y., employs a conventional propeller for travel afloat, while tractor treads enable it to take to the land whenever required. Windows in the steel hull are heavily screened as a protection against attacks of wild beasts, and portholes allow the occupants to use their guns or cameras. A short-wave radio installation provides a means of communication.

BREAD NOW FROZEN TO KEEP IT FRESH

BREAD is now being frozen to keep it from growing stale. Samples of bread kept in storage for a week, at a temperature below the freezing point, were tested at a recent meeting of New York cereal chemists, and were declared to compare favorably in aroma and flavor with freshly baked bread.



This odd flying machine, built by a French inventor, represents the latest attempt to fly by means of flapping wings. No such machine has ever made a successful flight

INVENTOR ATTEMPTS BIRDLIKE FLIGHT IN ODD MACHINE

ALTHOUGH all efforts to develop a successful "ornithopter," or plane that flaps its wings like a bird have so far met with discouragement, inventors in this country and abroad persist in attempts to construct one. The latest aspirant is a Frenchman named Dubois, who has built the odd machine pictured above, and hopes by pedaling it like a bicycle to lift himself from the ground. Records show that such machines have made more or less successful gliding flights, but none has achieved a sustained flight.

ROTATING SCREW DRIVES MOTOR SLED

PROPELLED over the snow by a rotating screw a motor sled of radical design has fulfilled its builders' expectations by conquering the 10,000-foot summit of Lassen Peak in the Sierras of California. On level terrain, its thirty-five-horsepower, air-cooled motor is reported to give the novel sled a speed of between fifteen and twenty miles an hour. One of the three aluminum runners is turned by a handwheel for steering.

TABLE MEASURES ANGLES

BY CONSTRUCTING a triangle, using a twelve-inch base line and an altitude read from a pocket table, a draftsman may draw any angle without a protractor. The diagram shows how the method is applied for angles less than forty-five degrees.

PIPES JOINED BY HEAT

AN ACETYLENE torch replaces a plumber's wrench in a new method of joining pipes, which obviates the use of threaded pipe fittings. When a pipe is slipped into one of the new-style fittings and the latter is heated, as shown above, a built-in ring of brazing alloy melts and is said to form a permanent, leakproof joint.

SLEEPING BAG HAS ARMS AND LEGS

A NEW kind of sleeping bag, which gives its user an overstuffed appearance resembling the silhouette of a penguin, has been invented by a Seattle, Wash., sportsman. Not only is the new bag considerably lighter to carry than conventional types, according to the designer, but it provides complete freedom of movement for hands and feet. On a chilly morning, for example, it enables a camper to arise and build himself a fire without foregoing the comfort of his warm bedding.

A sportsman building his morning camp fire while still wearing his sleeping bag. At left, the new bag in use for sleeping on the ground

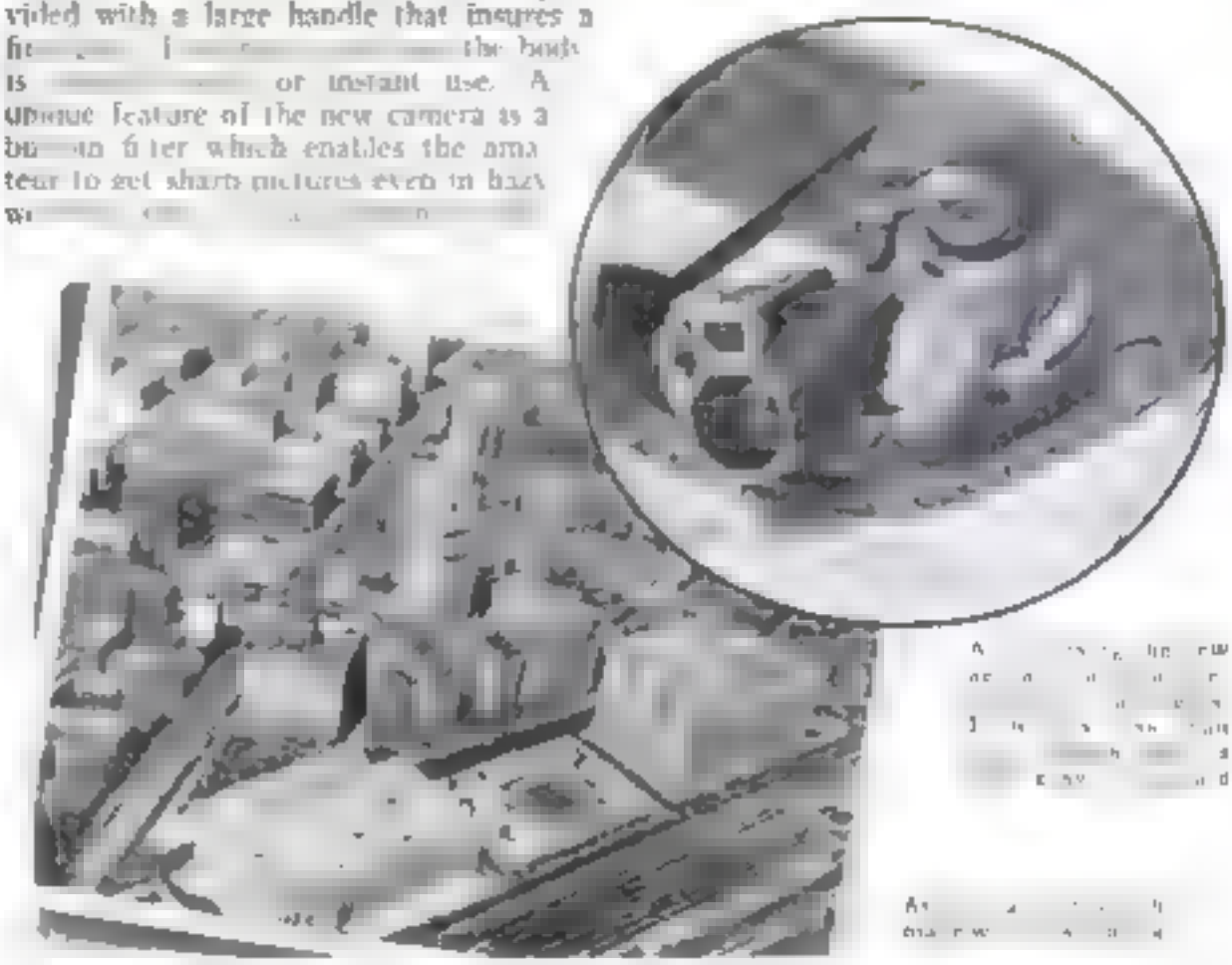
VACUUM FAN KEEPS WINDSHIELD CLEAR

MIDGET fans, operated by vacuum and clamped to the steering-wheel posts of automobiles, have been designed to protect motorists from frosted windshields during winter driving. The vacuum motor, which functions like that of an ordinary windshield wiper, is connected with the intake manifold of the automobile engine and spins the blades of the tiny fan at 4,500 revolutions a minute. Warm air driven upward against the windshield by the spinning blades, is said to keep the glass free of frost and steam.

AMATEURS GET COMPACT AIR CAMERA

WEIGHING less than four pounds, an aerial camera recently placed on the market is designed especially for amateurs. It is only seven and a half inches long, and takes standard 3¼ by 4¼-in. film packs. Its one-piece aluminum body is streamlined to reduce wind resistance and is provided with a large handle that insures a fi[illegible] the body is [illegible] or instant use. A unique feature of the new camera is a bu[illegible]on filter which enables the amateur to get sharp pictures even in hazy w[illegible]

essary, while using the camera in the air. That is to change the diaphragm opening for varying light conditions. The shutter has been designed and timed in such a manner as to eliminate the effect of the motion of the plane.

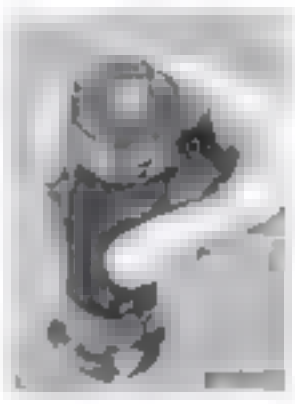


PROJECTOR CHECKS MACHINE PARTS

BASED upon the principle of the magic lantern, devices known as contour measuring projectors have been perfected for throwing greatly magnified images of small mechanical parts upon a screen. In this way, small articles such as gears, screws, threads, cams and dies may be inspected and compared with enlarged master drawings to insure precision. A new projector, shown in use at the right, provides four interchangeable distortion-free objectives that give magnifications of ten, twenty-five, fifty and 100 diameters.

Improved contour projector in use. It throws upon a screen enlarged images of small mechanical parts, so that they can be checked [illegible]

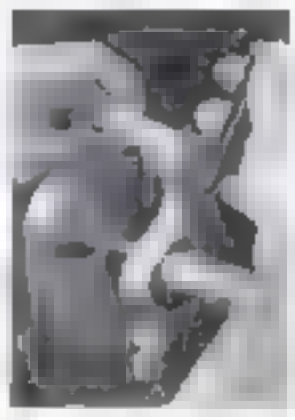
In the photograph at the left an enlarged image of the telephone plug shown above is being compared with a large master drawing



COMPASS IS BUILT INTO FLASH LIGHT

BY COMBINING a flash light and a compass, a New Jersey manufacturer has provided a handy accessory for campers and woodsmen. The compass occupies a position in the bottom of the light where it is protected from damage and at the same time is ready for instant use when needed.

IMPROVED LATHE DOGS LOCK WITHOUT WEDGES

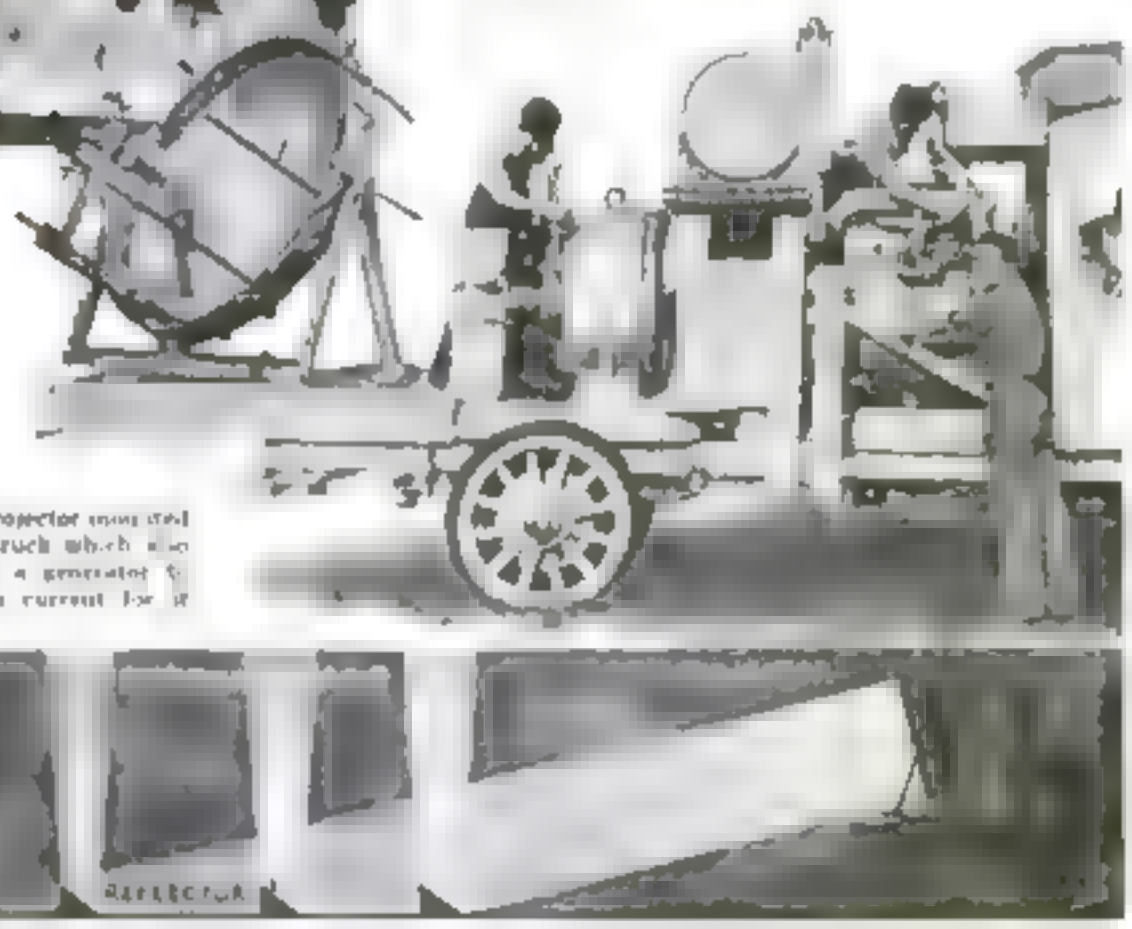


LATHE dogs of a new type, designed to eliminate play or backlash during operation, have been designed by a California inventor. In the ordinary dog, which is used to hold material being turned in the lathe, an engaging finger fits in a slot in the faceplate of the machine and small wedges secure it so there is no play. The new dog has an oval-shaped finger which can be turned and then secured in the position in which it completely fills the slot, thus making wedges unnecessary. According to the inventor, this feature saves time and eliminates trouble for the home-workshop enthusiast.

Heat Ray Sweeps Fog from Landing Field

New heat projector demonstrating its ability to dispel fog. A large "E" in a distant tree top serves as a target

FOG BANKS are reported to melt away before the powerful beam of a heat projector recently tested at Newark Airport, N. J. Its use at flying fields, according to the inventor, Samuel E. W. Haines, would provide a cleared path through which airplanes could land in safety. Resembling a searchlight without a lens, the projector is mounted on a truck for easy handling, and operates as a giant counterpart of the familiar bowl-type household radiant heater. Its heat is furnished by a dazzling electric arc, employing special electrodes and drawing several times as much current as an ordinary searchlight. Concentrated into a narrow beam, the heat destroys fog by turning the floating droplets of water into invisible vapor. For airport use, the beam would be trained along the ground and reflected into the sky at twenty-foot intervals by inclined panels covered with metal foil, producing a "tunnel" in the fog. The projector also could be installed aboard a ship so that the vessel could maneuver safely through a fog-bound harbor or channel.



The projector mounted on a truck which also carries a generator to furnish current for it

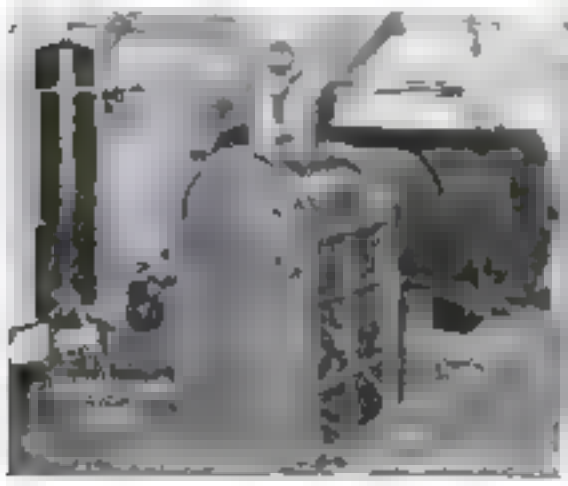
Drawing shows how the projector and metal-foil reflectors would be arranged to clear fog for flyers

CHECK STARFISH TRAVEL

OYSTERMEN have recently been startled to find brilliant blue starfish in the waters of Long Island Sound. U. S. Bureau of Fisheries men have colored thousands with a harmless dye and released them to find how far and how fast they travel. Information thus obtained will help combat the damage to oyster beds wrought by starfish which devour the oysters.

HOME PLANT MAKES GAS FROM WOOD OR RUBBISH

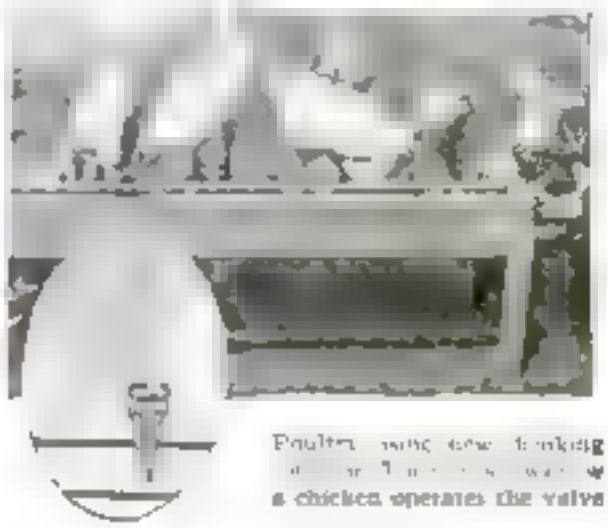
HOME OWNERS in rural districts may manufacture their own gas for cooking, heating, and refrigeration, with the aid of a household gas-generating plant recently placed on the market. The fuel—which may be either wood or waste material, such as corncobs, straw, or paper—is placed in a retort within a furnace where the gas is produced by destructive distillation. The [illegible] through [illegible] and [illegible] a storage tank or [illegible]. According to the makers, a single cord of wood produces enough gas to fuel the average family from two and a half to three months.



[illegible]

CHICKENS USE FOUNTAIN

DRINKING FOUNTAINS for poultry are a recent innovation. Special valves, set at intervals along a water pipe, open at the touch of a bird's beak and close automatically when released. Fowls quickly learn to use the fountains, it is said, and their use prevents the spread of disease.



Poultry using new drinking [illegible]. Here a chicken operates the valve

Hunting Wild Beasts

Howard Hill with a 200-p and bullelo bu I he killed in Wyoming. Note the arrow [illegible] At right [illegible]

ARMED only with a bow and arrows, a hunter stood on a slope of the high Wyoming Rockies and swept the surrounding country with his glasses. Suddenly he "froze," as the lenses picked out a huge bighorn on the side of a mountain six miles away. The sheep seemed to be staring directly at him; in fact, bighorns have been known to see a man as far as ten miles away.

Without moving, the hunter called to his companion to bring the horses up within view of the sheep, and told him to keep the animals in that spot until sundown. Noting carefully the exact spot where the sheep stood, he faded among the trees and set out along a hogback leading to the distant range.

For five hours he slipped and climbed over slick rocks. Crawling carefully behind the crown of the mountain keeping himself always hidden from the object of his long hunt, he advanced around a small promontory with an arrow ready to fly to the mark. As he raised his head slowly over the crest, he saw, not a hundred feet distant, two powerful horns, then the head. After having kept his lone vigil a full half day, the sheep continued to watch the distant horses and their keeper.

Rising silently, the archer loosed an arrow. As the deadly steel head struck the animal in the neck, the sheep leaped into the air like a tarpon. A second arrow crashed through his right leg. Four times the bighorn leaped, then fell 300 feet down the mountain side and slumped, dead—the first *ovis canadensis* known to have been stalked and killed by a hunter using bow and arrows.

It was Howard Hill, famous Alabama archer, who went west and bagged the monarch of the mountains. Though still only in his early thirties, Hill has proved many times that steel-tipped arrows in his hands possess the deadly accuracy and killing power of bullets from modern rifles.

This man's list of trophies reads like a catalogue of the animal world. He has loosed arrows at charging wild boars, black bears, buffaloes, wild jackasses, and wildcats when a miss would have meant death, he has killed sting rays and sharks as they sunned themselves off the Florida coast, rattlers and rabbits on the desert, possums and coons in southern pines, fish and gators, and snakes in the bayous and canals of the South, and birds on the wing.

Trained by the Seminole Indians to stalk game warily, Hill dresses for the part. He never appears in solid blue or khaki whether in the Big Cypress swamps of the South, in Canadian birch, or on the Mohave Desert, but camouflages himself by wearing dark, mixed colors.

Hill is so accurate that he never hunts "backed up" by a gun bearer, for he can pump five arrows into an enraged animal with the rapidity of a repeating rifle. His concave broadheads possess a penetrating power equal to that of steel-jacketed bullets. Equipped with an English-type bow five feet, ten inches long made of Florida snakewood or split, laminated bamboo, requiring a 110-pound pull, he will face any killer of North American forest or swamp, confident that he can send at least one killing shot into the chest cavity before the beast reaches him. The spring-steel broadheads which Hill designed for his own hunting provide a cutting width of one and one eighth inches. He has, on occasion, driven such an arrow entirely through the body of an infuriated 1,000-pound black bear as it lunged straight for him.

Begin where you like, on a western desert, in the Wyoming Rockies, or deep among Florida pines, and you'll probably

With this apparatus, Hill tests the "weight" of a bow, or the amount of pull required to bend it. The balance of the limbs is corrected as shown in picture above

with Bow *and* Arrow

This article tells of the amazing feats of a daring archer in whose hands primitive weapons are as deadly as modern firearms

By ANDREW R. BOONE

Hill shooting fish in a mountain stream. He is [illegible]

pick a spot where Hill has stood silent with his bow, awaiting that split second when he could loose a feathered messenger of death.

On the Mohave Desert, the other day, he [illegible] rabbit to her young [illegible] -he reached her den where the babies lay waiting for their breakfast a wildcat stumbled across her path. The coyote dropped the rabbit and sailed into the wildcat So furiously did the battle rage that neither animal saw the hunter as he crept up on them. He approached within twenty-five yards before nocking an arrow and, with a snap shot drove an arrow through the cat

Meanwhile, a second wildcat apparently thinking it was anybody's fight, approached from the side of the trail. Seeing his first arrow fly true to the mark Hill whirled, nocked another and, from a distance of fifty yards, loosed this one at the unsuspecting intruder. Shot through the heart the desert marauder died instantly not knowing what had struck him.

At the end of a long hunt on the Shoshone Reservation in Wyoming, Hill dropped on one knee, took careful aim and fired at a black bear. The arrow flashed across a narrow canyon and struck the bed on which the bear was resting The second arrow missed, and the bear now thoroughly aroused, charged. As the brute crashed through undergrowth and trees, Hill loosed a third shaft, the steel head striking the animal in the left leg and sending him rolling in the snow With the speed and skill of a rapid-fire marksman, Hill drove more arrows into the infuriated bear The seventh found the chest cavity, the eighth and last cut through the skull. Thirty seconds later the animal breathed its last, dropping almost at the archer's feet

Hill attributes his [illegible] skill to long and constant practice and great physical energy He pulls a powerful bow with the ease of a child bending a twig. He shoots steel tipped hunting arrows long distances with the precision of an artilleryman, bracketing his prey [illegible] he sends a killing [*Continued*]

By placing a feathered arrow across a coiled string Hill [illegible] an arrow [illegible]

The [illegible] demonstrated here shows whether an arrow [illegible] jumps off the fingers. It is rejected

Hunting and target arrows in various stages of manufacture Note how the footing of stronger wood is incorporated in the heads to make them heavier

HAND PUMPS AND TIN CANS

Start Miniature Oil Boom

WITH spade and auger, Cristobal Salcido had nearly completed a twenty-foot cesspool in his backyard in Wilmington, a suburb of Los Angeles, Calif., when he noticed a colorless liquid trickling into the bottom of the hole. Collecting a pailful, he tested it and found it to be high-gravity oil, so volatile it would run an automobile.

For three weeks he kept his strange well a secret and collected the fluid in barrels, selling it to motorists at a low price. Then his neighbors heard about it—and the boom was on. Dozens of other people soon were eagerly digging shallow holes and baling gasoline from them with buckets or with hand pumps. Strangely, gasoline pumped from different sections of this back-yard oil field comes in various colors—black, red, yellow, and white.

Because of the fire hazard, city authorities soon stopped the incipient boom, citing a law which forbids drilling for oil except with standard derricks and other drilling equipment.

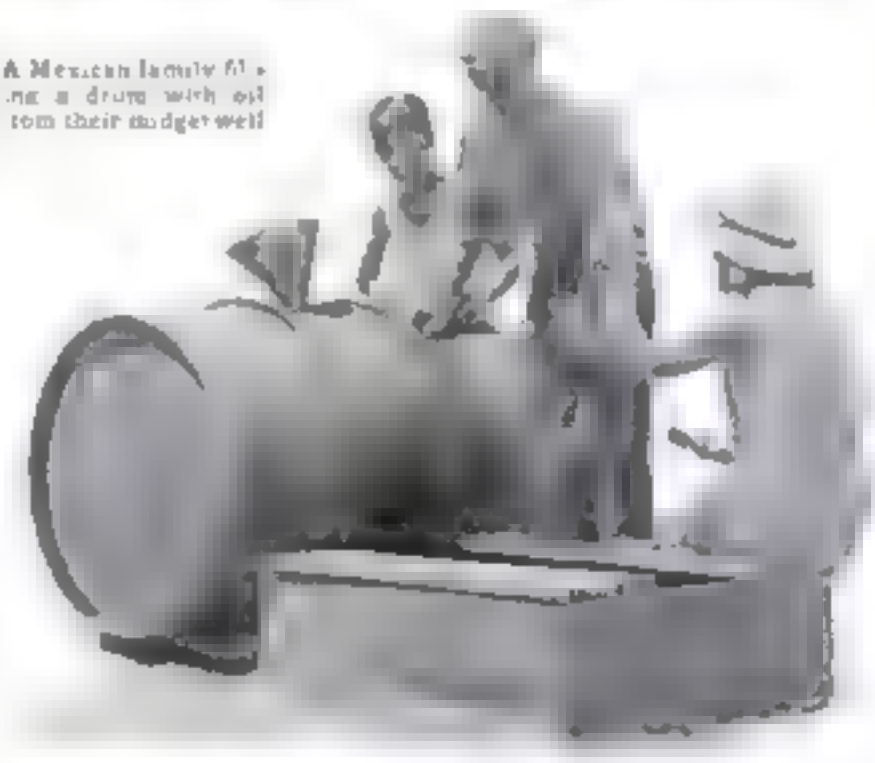
Finally, the Los Angeles City Council decided to permit oil production to continue in the Wilmington section for six months, under certain restrictions. A bond of $100 must be posted for each hole drilled, as a guarantee that the ground will be filled in if the well is abandoned. A fire extinguisher of at least three gallons capacity must be kept near the well. All gasoline produced must be stored in steel drums and removed from the field the day it is pumped; no more than six drums, holding fifty-five gallons each, are allowed for each well. A five-dollar drilling permit and a production permit costing two dollars for three months are required.

No motive power is allowed except vapor-proof electric motors, and, as these are out of reach of the small operators, nearly all pumping is done by hand. Salcido, the discoverer of the field, has four sons who help him; less fortunate operators are forced to hire boys to work the pump handles, paying them twenty or twenty-five cents a barrel.

The gasoline is found under twenty feet of filled-in earth, on top of the blue mud of the old harbor bottom. Many oil men account for its presence by the theory that wet gas from near-by oil fields, escaping through crevices from lower oil sands, goes through a natural refining process while passing through the ground. Several large oil fields, including the famous Signal Hill development, lie within a distance of five to twenty miles from this remarkable deposit of natural gasoline.

Although the miniature oil boom at Wilmington is unusual in that it yields high-gravity oil suitable for use in automobiles without artificial refining, it is by no means the only example of small-scale oil production. The country is dotted with fields of midget wells, some producing only a few gallons a day, others pumped intermittently with rest periods while the hole fills up again. In some places, oil is mined through shafts sunk directly into the sands; in others, portable drilling machines, mounted upon trucks, go from place to place putting down large numbers of shallow holes at small cost.

Many of the midget wells are the result of exploration for water. In Texas, a cattle raiser drilled on his 20,000-acre ranch hoping to strike a supply of water for his stock; instead, he got oil at the rate of fifty barrels a day. Just the reverse was the experience of a Canadian who drilled for oil and struck a flow of mineral water



A Mexican family filling a drum with oil from their midget well

By
EDWIN
TEALE

Below, Joseph Kvet with the model a power watch he uses for endurance under fuel restrictions for official contests

Midget Motored Models

RUN THRILLING RACES IN AIR AND WATER

A one-cylinder engine, made with the precision of a fine watch, powers this model. Details of the engine and its compact assembly are illustrated

engine running for nearly twenty minutes.

With an engine of this type the sleek, streamline model with which Leo Weiss, of New York City, carried off the prize at the National Championship Model Plane Meet held at St. Louis, Mo., last summer, reached a top speed of more than a mile a minute

In official competitions, each model is allowed an eighth of an ounce of gasoline for every pound it weighs. This cuts down the length of the flights, thus reducing the number of lost models, while, at the same time, it puts all competitors on an equal footing. For fuel, gasoline is mixed with heavy lubricating oil in the proportions of four to one. When test hops are made, a medicine dropper is used to put fuel in the tank. Two dropperfuls are sufficient for a machine to get into the air, circle the field, and float in for a landing

At present, the world's record for models carrying the prescribed amount of fuel is held by Joseph Kovel, a veteran model maker of Brooklyn, N. Y.

Last spring, during a meet at Hadley Field, N J., Kovel's ten-foot machine soared to an altitude of 3,000 feet and circled away into the southwest. With official timekeepers, he followed it in a fast car. For half an hour, they raced down country roads. A blowout stopped them. They changed to a second car and continued the pursuit. Again, tire trouble overtook them and they had to watch the model, heading in the general direction of Philadelphia, disappear from sight. It had been in the air sixty-four minutes and forty seconds.

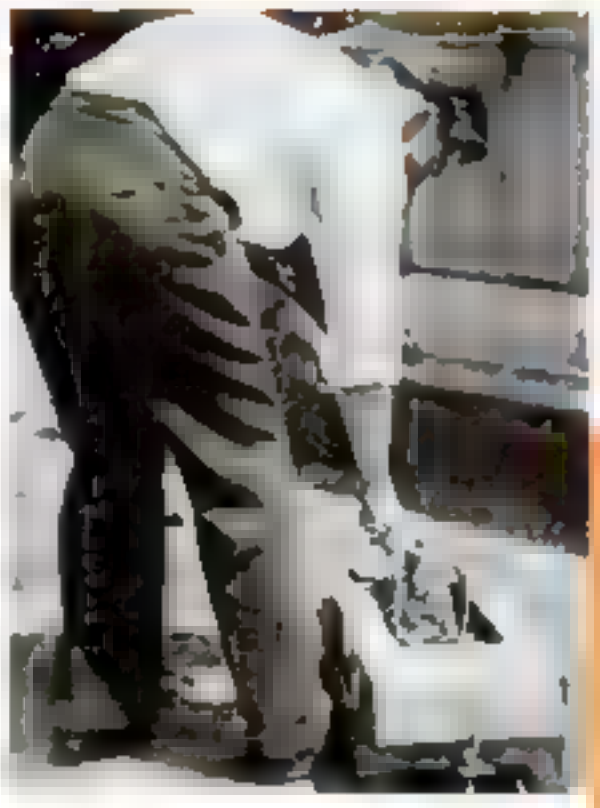
How long it rode the air currents after that, no one will ever know Two days later, it was found in a field near Metuchen, N. J. It had traveled at least thirty-five miles from its starting point and, as the torque of the propeller keeps such models turning in wide circles, its total air mileage must have been much greater

When one of these machines is tuned up for the take-off, the control surfaces are set in position for the best gliding angle of the ship. The pull of the propeller at the nose of the craft lifts it sufficiently to make the model climb or fly on a level keel as long as the motor runs. Then, when the engine cuts out, the ship automatically goes into a glide that brings it to earth in a long descent. The high-wing design of most of the planes is

slowly into the air, and soared off toward the south. In a big plane piloted by Jack Byrne, Bassett trailed after his model.

With its little engine chattering away, it crossed the Delaware River, passed over the outskirts of Philadelphia, left Pennsylvania behind, and soared out over the farms of northern Delaware. When its fuel finally gave out, it was a mile and a half in the air over Armstrong's Corner. It coasted down for a perfect landing and Bassett recovered his record-breaking model undamaged. It had traveled more than fifty miles on seventeen ounces of mixed oil and gasoline

The type of motor used on this flight as well as on most other record-smashing journeys of model planes, was designed by William Brown, a young Philadelphia enthusiast. Brown's motor weighs only eleven and a half ounces, complete with fuel tank, coil, and condenser, and it develops approximately one-fifth horsepower. Its single cylinder is machined from a solid bar of alloy steel and its crankcase is die cast and made of aluminum-silicon alloy. With a bore of seven eighths of an inch, and a stroke of one inch, the pygmy motor "winds up" to 6,000 revolutions a minute. An ounce and a half of fuel will keep the



A model boat racer starting his engine on dry land by pulling a cord attached to its tiny flywheel

Held to a circular course by a fish line, a model speed boat races against time in a contest on a California lake

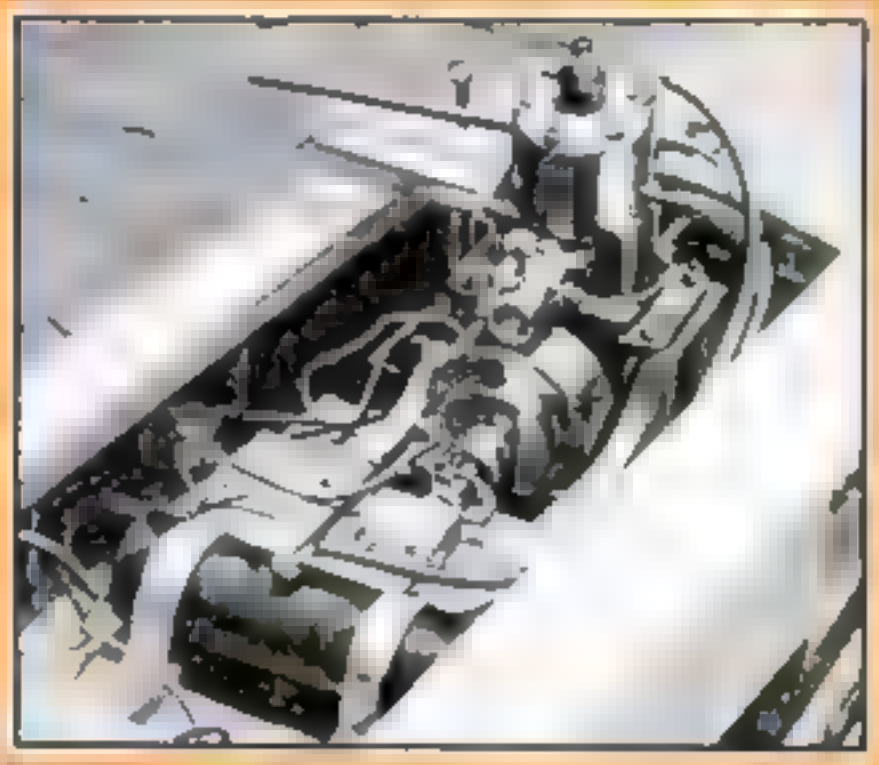
calculated to keep them balanced in the air.

How much one of these planes, and its midget motor, will stand, was demonstrated by a spine-tingling, 1,000-foot power spin at Caldwell, N. J. During a meet there, one of the machines was circling high overhead when a bracing wire snapped. One wing folded back and the ship gyrated down in a power spin. It struck so hard the nose and motor were buried in the ground. Fortunately, the spot where it hit was soft. The owner dug out his machine, washed the motor in a pail of gasoline, put on a new wing, and had his plane back in the air in an hour's time!

Crashes provide much of the excitement and fireworks at a gas-model meet. At Caldwell, for instance, one machine ran full-tilt into a big biplane warming up on the line. Curiously enough, it was the large machine that came out second-best. It had its wing fabric torn, while the only damage to the model was a broken propeller. Less fortunate was another model at Lakehurst, N. J. It ran smack into the *Los Angeles*, the huge U. S. Navy Zeppelin. The little plane struck head-on, bounced back, and fell apart in the air.

Many early models had propellers that were too light. If the engine missed once in the air, the propeller lacked sufficient weight to keep on turning until the engine caught hold again. Weak batteries are the most frequent cause of motor trouble. Two small flashlight batteries supply current for the midget ignition system, and they have a life of about one hour.

In shallow lakes and ponds, model boats race around tethering poles like the one seen in this picture



An engine installation in a one-meter hull. The protruding lever is a switch which is tripped with a pole if the boat gets out of control

During one recent meet, a contestant cranked his propeller and tinkered with his engine for an hour before he discovered that the batteries were dead. Then, he failed to secure the new ones tightly and they slid forward in the air, bringing his plane down in a 500-foot power dive that left the craft in splinters.

Without doubt, the crash that caused the most excitement was one reported from Los Angeles, Calif. Three radio police cars and an ambulance converged on a vacant lot where the model plane was wrecked. The realistic drone of the little motor, as the 7½-foot model circled over the neighborhood before the crash, deceived residents into thinking it was a real plane in trouble. When it struck the ground, they telephoned in an alarm which brought the radio cars, the ambulance, and several thousand spectators.

Five years ago, almost every flight made by a gas model ended in a crash. Only recently have designers overcome problems that stood in the way. Two of the pioneers in the field were Bassett and Brown, in Philadelphia. They began testing experimental models in 1929. Bassett built and crashed eight ships before he got one that flew, and Brown worked for two years before his midget motor was a success.

Up to the 1933 national meet, held at Roosevelt Field, Mineola, N. Y., gas models made such a poor showing that they were allowed to compete in the rubber-band class. That year, Bassett stole the show. His model won every important prize in the competition. Since then, gas models have had contests of their own. So rapidly has the interest increased that at this year's

The rubber balloon under the port at wing of this model force feeds the tiny carburetor during a race

Propeller shaft strut of a model boat, with horizontal fin to end porpoising and holes which scoop up water to cool the craft's engine

Luthiel Morris, Jr. of Venice, Calif., with the miniature four-cylinder, four-cycle motor he built to install in a radio-controlled model boat

national contest at St. Louis, sixty-five gas-powered planes were entered. Brown Jeffrey has sold upwards of 900 little engines and scores of enthusiasts are building their own power plants

The most successful model so far has probably Kovel's record-breaker. It has made forty flights without a crack-up. On one day, it made ten perfect take-offs and landings. The nearest it has come to a crash occurred on its first successful flight at the Vermont farm of Charles Hampson Grant, the designer of plane. Starting from a strip of tar paper, laid down on top of the grass in a meadow, it climbed into the air and circled about for fourteen minutes. When the engine stopped, the machine was headed directly for a dense wood of sixty-foot maples. It disappeared among the tree tops. An hour later, Kovel and Grant discovered the ten-foot plane upright on its wheels, unharmed, in the middle of the forest. Evidently, it had been dropped from one leafy branch to another until it reached the ground.

To control the movements of a gas model in the air Chester Lanzo, of Cleveland, Ohio, is installing a tiny radio outfit. Other enthusiasts are incorporating original ideas in the design of gas models. The latest development is a six-foot autogiro driven by a vest-pocket power plant

At present, many model makers are prevented from entering the field by the cost of the engines. They run close to twenty-five dollars, and the material for the plane comes to almost as much. So the investment in a gas model is nearly fifty dollars, not considering the time spent in the work of construction

However, several owners are putting their models to work and are getting back part of their investment. One, in Kansas City, Mo., advertises a well-known brand of gasoline. Another in the West, advertises a motor oil, a third a dope for treating the wings of airplanes. In South Carolina, Bob Scarborough is learning to fly with the help of his seven-foot model. Week-ends he flies it at the local airport and attracts large crowds. Many of the spectators go for rides in the big planes and, in return, the pilots give Bob free time in the air

Less expensive is the sport of racing midget boats powered by high-speed pygmy engines. Material for the hull of such a boat can be purchased for as low as three dollars. All over the country, clubs and individual enthusiasts are enjoying the thrill of racing their homemade craft against time

On some California lakes, contests are held once a week, and, in the East, when the annual classic sponsored by the New York Society of Model Engineers takes place, entries come from hundreds of miles away. Imagine yourself at one of the Sunday-afternoon competitions on a West Coast lake

An old skiff puts off from shore. In it are the contestants, their little boats, tucked under their arms, looking like oversize wooden shoes. The bottom of the skiff is crowded with tools, funnels, gasoline cans, and tiny spare spark plugs. In the middle of the pond, the skiff comes to anchor, and the first contestant makes ready to run his race against time

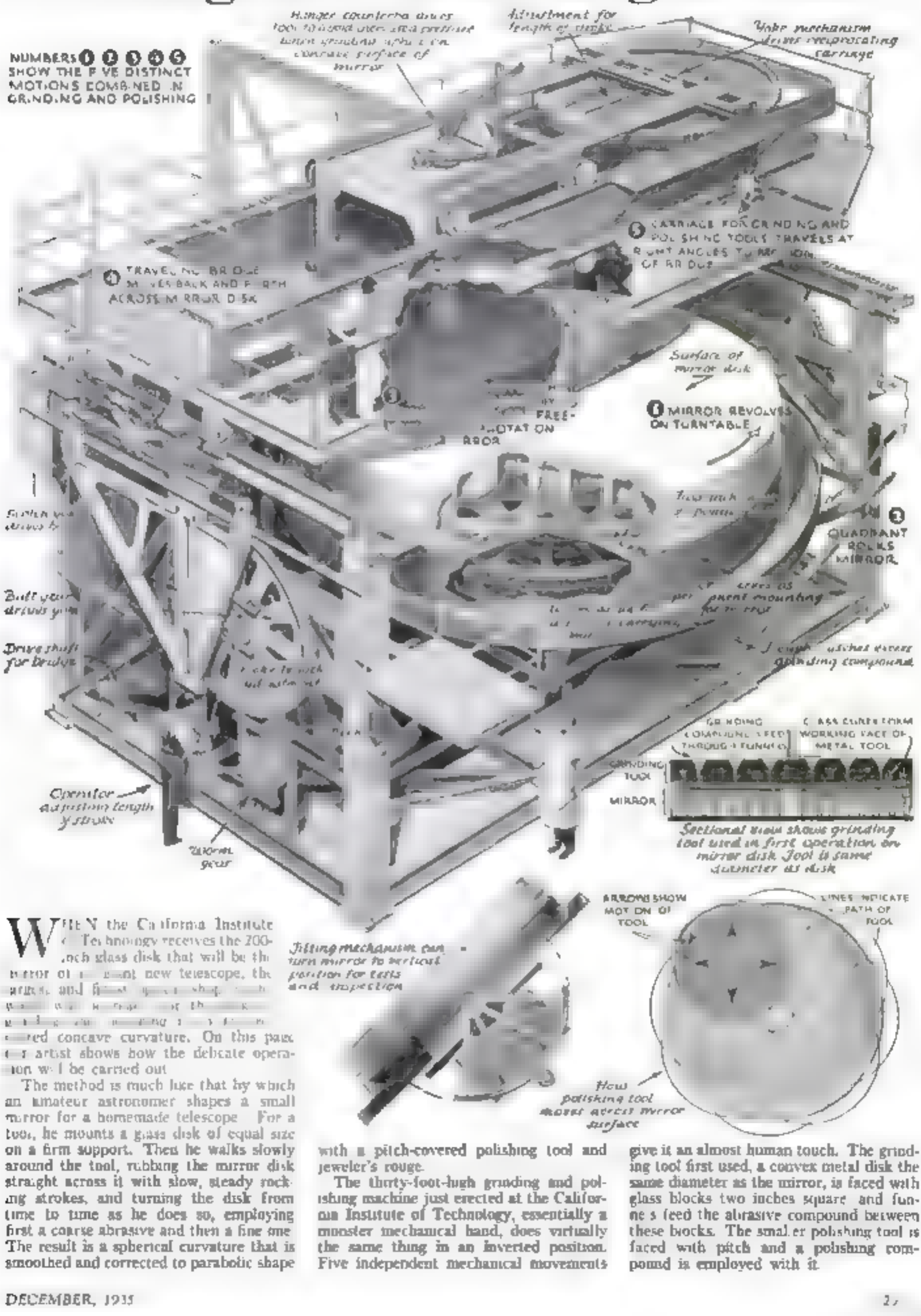
This model monocoupe, built by Bruce Thomas, of Staten Island, N. Y., is powered by a one-cylinder gasoline engine weighing six ounces. The plane takes off realistically and flies from six to eight minutes on one ounce of gasoline fed to it from a medicine dropper

You see him carefully attach a fishline of 150-pound strength to a brass plate on the side of his little boat. This line runs to a stubby fishing rod equipped with a large reel. With it, he will hold the racing model to its course when its dash begins. Next he blows up a small rubber balloon. Bending down, he attaches it to the air intake of the gasoline tank. The pressure of the air in the little balloon force-feeds the carburetor during the race. The tank holds from four to five ounces of fuel mixed with lubricating oil

Finally, he jerks a rope wrapped about the flywheel of the engine. The midget power plant goes into action with a sound like that of a machine-gun. Its propeller thrashes the water. All is set for the start. The contestant points the boat away from the skiff and flips open the timer and throttle. With a roar the thunderbug is off, planing, bucking, making almost as much noise as a class F outboard running wide open

Gradually the contestant plays out the line until the little boat is circling the skiff in a clockwise direction at the end of a taut, fifty-foot string. Out come the timers' watches. The little hull streaks past the bow *(Continued on page 112)*

Grinding the World's Largest Mirror



WHEN the California Institute of Technology receives the 200-inch glass disk that will be the mirror of its giant new telescope, the grinding and final [illegible] ground with a concave curvature. On this page the artist shows how the delicate operation will be carried out.

The method is much like that by which an amateur astronomer shapes a small mirror for a homemade telescope. For a tool, he mounts a glass disk of equal size on a firm support. Then he walks slowly around the tool, rubbing the mirror disk straight across it with slow, steady rocking strokes, and turning the disk from time to time as he does so, employing first a coarse abrasive and then a fine one. The result is a spherical curvature that is smoothed and corrected to parabolic shape with a pitch-covered polishing tool and jeweler's rouge.

The thirty-foot-high grinding and polishing machine just erected at the California Institute of Technology, essentially a monster mechanical hand, does virtually the same thing in an inverted position. Five independent mechanical movements give it an almost human touch. The grinding tool first used, a convex metal disk the same diameter as the mirror, is faced with glass blocks two inches square and funnels feed the abrasive compound between these blocks. The smaller polishing tool is faced with pitch and a polishing compound is employed with it.

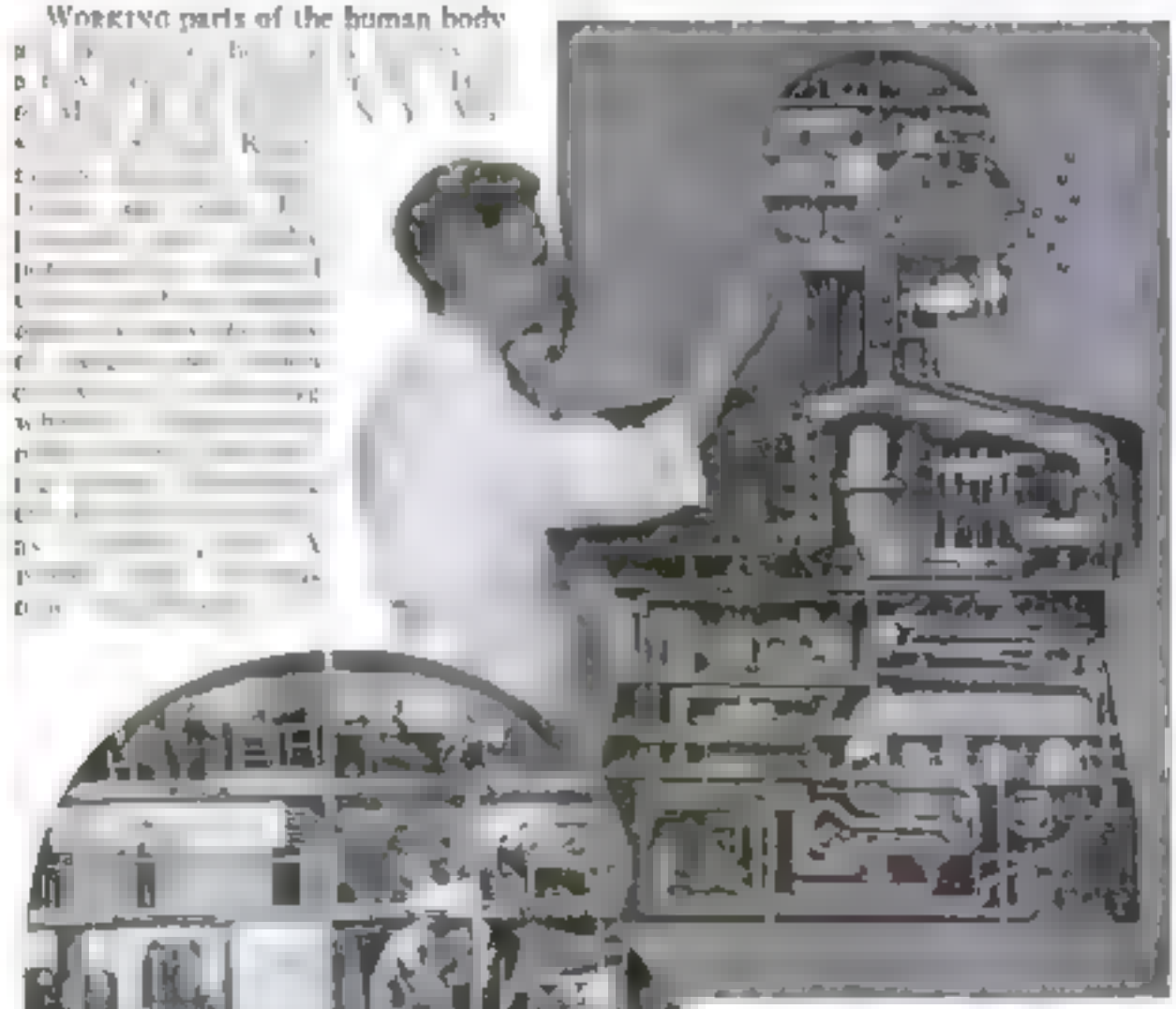
NEW METHOD PRODUCES COLORED ENGRAVINGS ON JEWELS

A tiny diamond-point drill is used to carve the delicate designs

EMPLOYING a new technique of his own invention, a young California craftsman, Francis Behrens, produces colored portraits, landscapes, and monograms upon semiprecious jewels. His first step is to carve the design upon the stone with a tool resembling a dentist's drill, using a diamond point and a tiny rotary disk charged with diamond dust. Pigments and dyes, made according to his own formulas, are then brushed into the carved portions and the colors are made permanent by heat treatment. Among the stones he uses are moonstone, onyx agate sapphire, chalcedony, sardonyx, and opa.

Using binocular lenses, small tools, and special dyes, this craftsman carves colored engravings on jewels such as are shown at right

MODEL PORTRAYS MAN AS A FACTORY



This mechanical man shows how [illegible] schoolroom. Control of Glands, indicator and regulating panel; Muscle Center, railroad switch tower; Will Power, executive meeting [illegible]; Hearing, sound studio; Vision, photographer's studio; Nerve Center, telephone switchboard

AMATEUR GETS UNUSUAL LIGHTNING PHOTOGRAPH

WHEN an electrical storm overtook a fishing party near Constantia, N. Y., not long ago, R. George Roesch, amateur photographer, set up his camera to try to catch a picture of lightning striking the lake. Luck favored him. Hardly had he opened the shutter, set at "time exposure," when there was a blinding flash and a terrific bolt struck the water some 400 feet away. The result was the remarkable photograph reproduced above, which is probably one of the best pictures ever taken of lightning striking water.

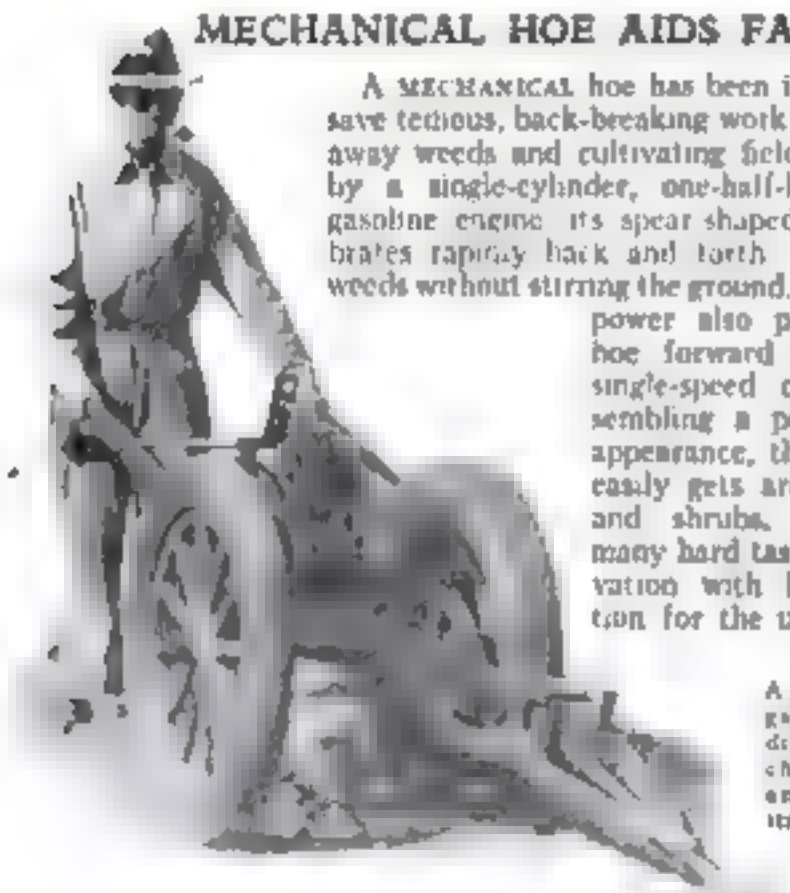
Huge Aerial Photograph Shows Entire State

The State of Connecticut as it appears from the stratosphere. More than 10,000 photographs went into th a map

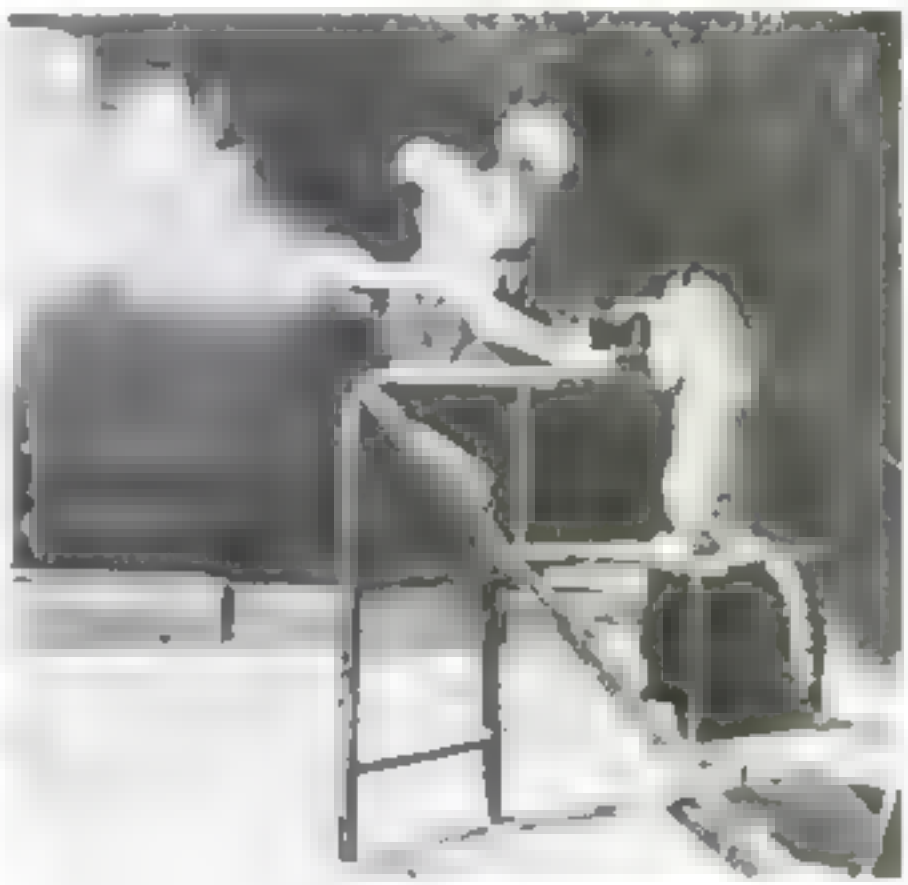
BINOCULARS are needed to inspect a giant aerial map o Connecticut, called the largest of its kind and measuring eighteen feet across the bottom. The "stratosphere view," just completed, is said to be the first photograph to show at one glance what a whole state looks like Even such details as hedges and chicken houses are visible when the picture is closely inspected. To make it, aerial surveyors made 10,479 exposures, which were combined into thirty-four composites, and these in turn were carefully joined together to form the complete map

MECHANICAL HOE AIDS FARMERS

A MECHANICAL hoe has been invented to save tedious, back-breaking work in clearing away weeds and cultivating fields. Driven by a single-cylinder, one-half-horsepower gasoline engine its spear shaped blade vibrates rapidly back and forth cutting off weeds without stirring the ground. The same power also propels the hoe forward through a single-speed drive. Resembling a push-hoe in appearance, the machine easily gets around trees and shrubs, and does many hard tasks of cultivation with little exertion for the user



A one-cylinder gasoline engine drives this mechanical hoe and vibrates its spear blade



Training by laboratory workers has overcome the puma a fear of firearms

ULTRA-STREAMLINE PLANE IS FLYING WIND TUNNEL

TO REDUCE flying craft to the most efficient streamline shape, an inventor of Oakland, Calif., proposes the curious design shown in the accompanying illustrations. His craft, a veritable flying wind tunnel, consists of a cigar-shaped fuselage pierced by a twin-mouthed air duct Tractor propellers drive the craft forward and also force air backward through the duct, creating a lifting force as a result of the back pressure against its curved upper wall. A further lifting effect is provided by increase of air density beneath the wings of the plane where the air is discharged

PUMA CALLS FOR FOOD BY FIRING A CANNON

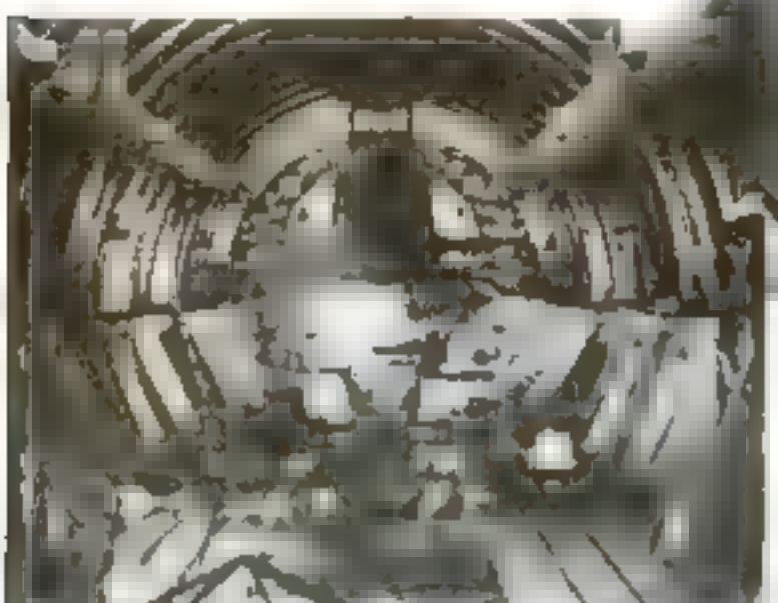
THOUGH most animals are gun-shy a wild puma kept at a laboratory in Moscow Russia deliberately fires a cannon to signify that it is hungry Laboratory workers trained the animal, in accordance with the theories of Dr Ivan Pavlov, noted physiologist, by firing the piece and giving the puma a piece of meat after each shot Soon it overcame its natural dislike for the sound and learned to get its meals by climbing upon a platform and pulling the firing cord.

TUNES ARE CATALOGUED IN MUSICAL DICTIONARY

NEW TUNES reveal their kinship to old ones, in a musical dictionary just completed in Vienna, Austria. Thousands of musical themes are recorded. An entry is made for each composition, which is transcribed in letters of the musical scale, the letters of the first few notes serving as "initials" for filing guidance

Movie Forecasts Tunnel Under Atlantic

WHAT travel between Amer[illegible] Europe may be like a half-century or m[illegible] is [illegible] productions, wh ch env[illegible] a 3,000-mile submarine vehicular tube link ing New York and London. To offset the ob tion that such a project would be fantastic un der engineering methods developed up to the present time, the movie, "Transatlantic Tun nel," provides the builders with an [illegible] new tool—a "rotating drill" supposedly [illegible] of liquefying rock. Streamline, her[illegible] sealed cars, impelled by electromagnets at traveling in a vacuum, according to the story would whiz through the completed tube at such terrific speed that a passenger could breakfast in New York, keep a luncheon engagement in London and get back to America for [illegible]



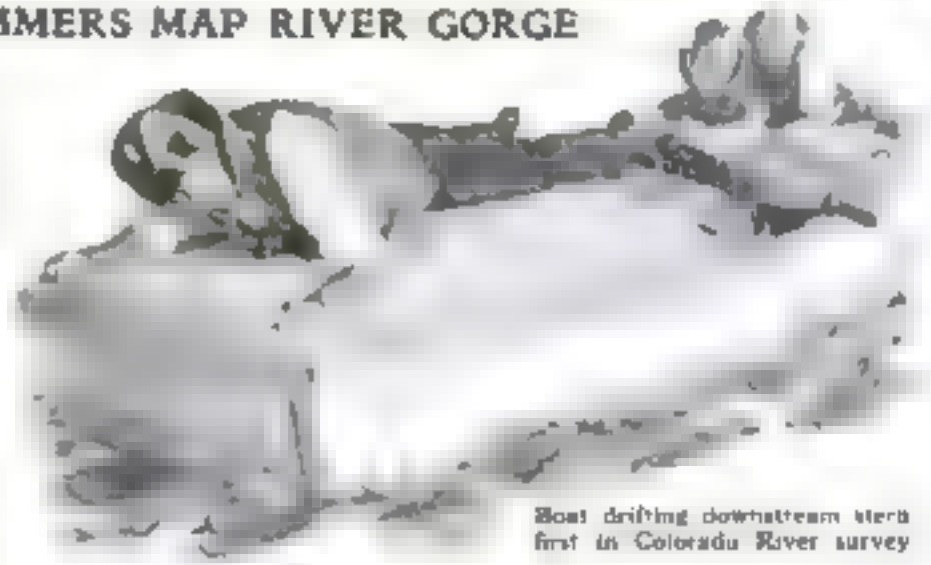
TO ENGLAND UNDER THE SEA

[illegible]

This glass globe is filled with [illegible] paint to mark thugs

DARING SWIMMERS MAP RIVER GORGE

TO COMPLETE a map of Boulder Dam Reservoir, expert swimmers, wearing helmets and padded life preservers, have begun a perilous fifty-five-mile survey of the Colorado River gorge. They will fight swift currents and dodge jagged rocks in boats with water-tight hatches and battering-ram sterns.

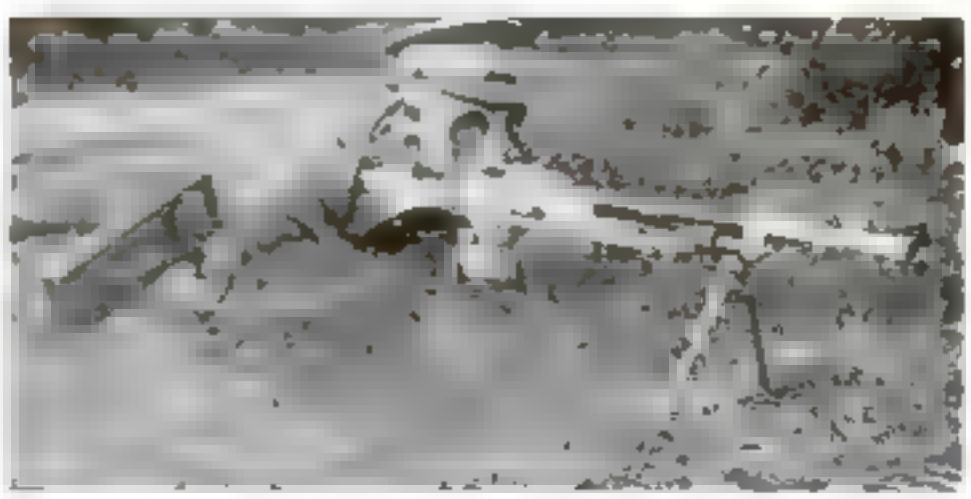


Boat drifting downstream stern first in Colorado River survey

BOMBS SMEAR BANDITS WITH TELLTALE PAINT

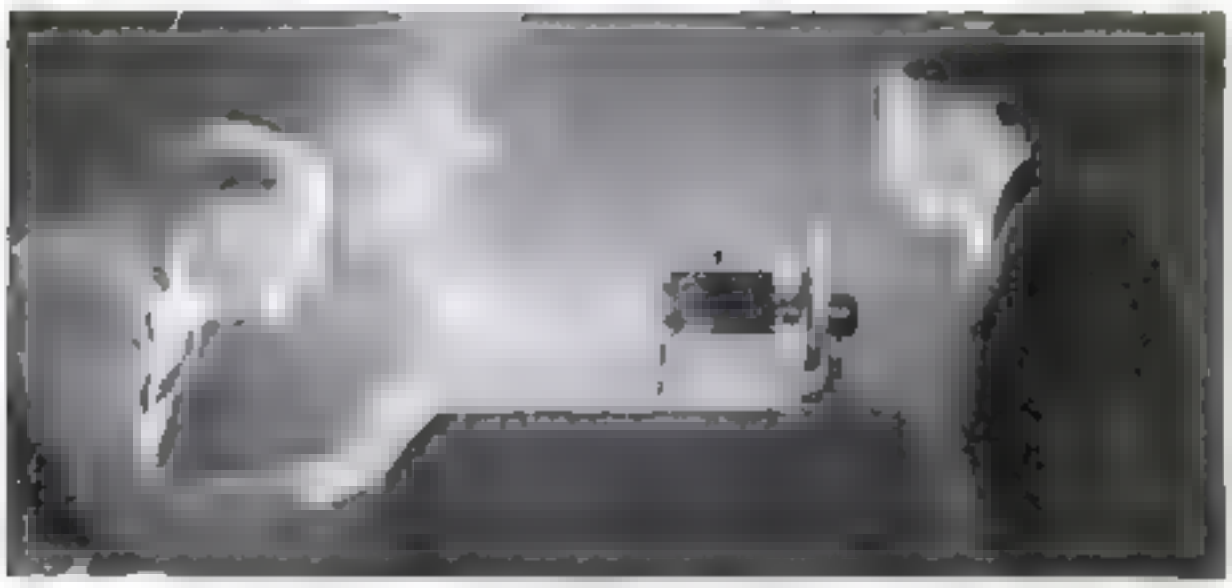
GLASS bombs resembling electric-lamp bulbs, filled with brightly colored paint, are a new British weapon against holdup men. Night watchmen and payroll messengers, carrying supplies of the bombs, are prepared to hurl them at fleeing suspects or escaping bandit cars. The resulting smear of yellow or red ocher paint makes it easy for police to trail the fugitives, and the firing of guns that might endanger passers-by in crowded streets and thoroughfares is avoided.

GUNNERS WIELD RATTLES IN SHAM WAR



A rattle being used by a British machine gunner in place of blank cartridges

SWINGING large wooden rattles, gas-masked gunners engaged in mock combat during recent British army maneuvers. The toy noise-makers simulated the sound of machine-gun fire and permitted economies in the use of blank cartridges. Ignoring its incongruity, umpires checked the theoretical effectiveness of the make-believe fire.



Engineers testing the inner workings of a new electrical dust precipitator for household use

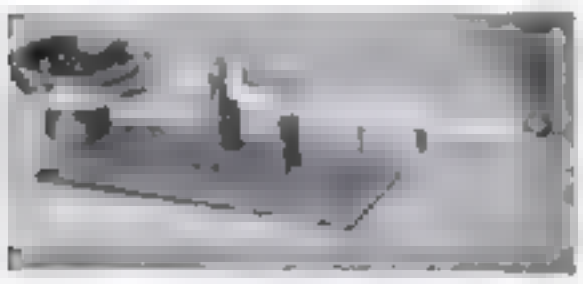
ELECTRIC PLATES CLEAN AIR IN HOME

RELIEF for hay-fever sufferers is promised by an electrical "dust precipitator" that removes irritating pollen, as well as dust and soot, from the air in a bedroom or office. As air passes through the device which is designed to be housed in a decorative cabinet, all floating particles of foreign matter are attracted electrically to charged aluminum plates that serve as collectors. The plates are cleaned periodically, simply by holding them under running water. Successfully tested by Westinghouse engineers, the device is a small-scale counterpart of huge electrical precipitators used in industry to prevent the escape of soot and dust from plants.

DRILL FOR GLASS HAS RUBBER SUCTION GUIDE

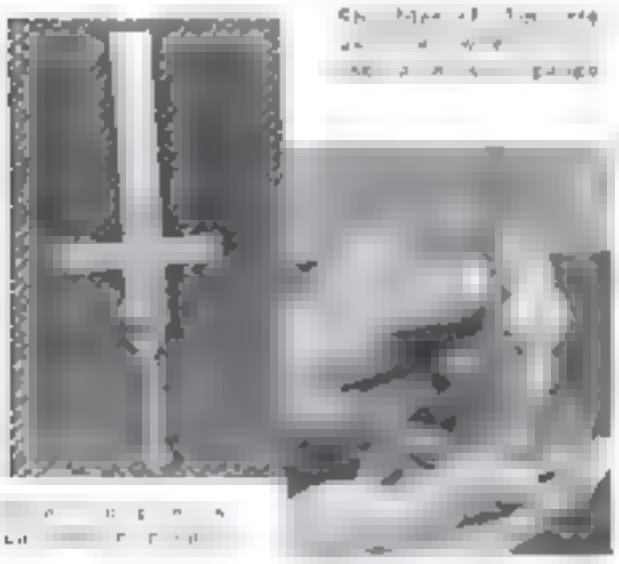
HOLES ranging in diameter from one-half inch to four inches are neatly bored in glass, stone, tile, or porcelain with a new drill equipped with a rubber suction guide. The latter, clinging to the surface of the work, holds the tool firmly in place and prevents chattering or vibration, assuring a smooth high-speed job. Tubular cutting heads, to bore holes of different sizes, are interchangeable in the device. According to the manufacturer, the tool may be used in a horizontal, vertical, or slanting position with equal convenience.

Drill equipped with rubber suction guide for boring holes in glass and similar materials



MIDGET BALANCE WEIGHS CHEMICALS ACCURATELY

HANDY for both amateur and professional chemists, a new pocket-size balance has a capacity of 100 grams and is said to be accurate to within one one-hundredth of a gram. Measuring only twelve inches long, the balance employs permanently attached sliding weights, and a beam arrest protects the alloy-steel knife edge and agate bearing when it is carried

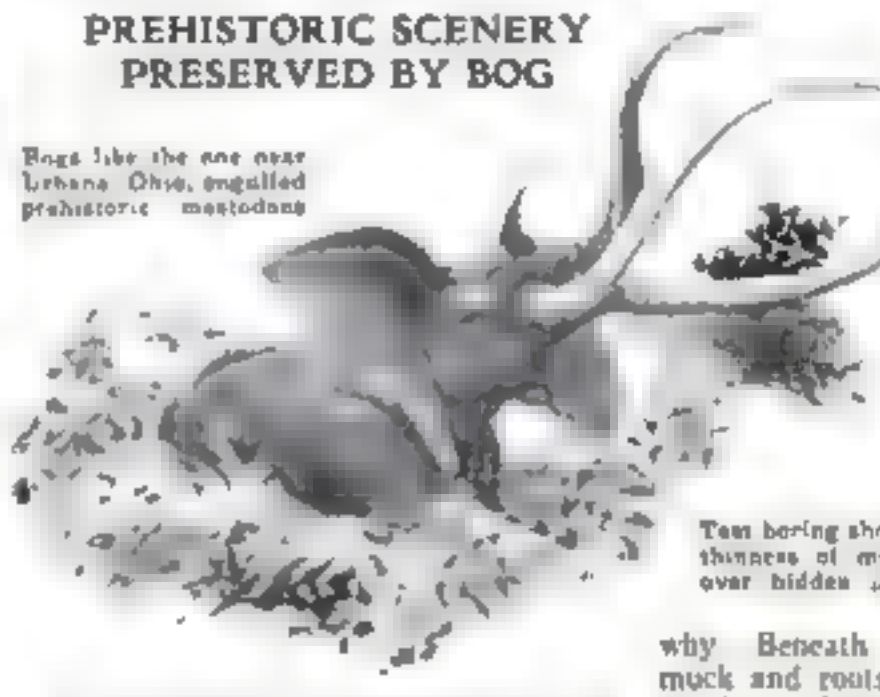


POCKET RULE SERVES AS DEPTH GAUGE

A POCKET CLIP with a T-shaped shoulder enables a new six-inch steel rule to be used in the shop as a depth gauge, as well as for ordinary measurements. When the rule is dropped into a recess and the clip is slid into place to serve as a marker, the depth may be read from either side. One side is graduated in thirty-seconds and the other in sixty-fourths of an inch

PREHISTORIC SCENERY PRESERVED BY BOG

Bogs like the one near Urbana, Ohio, engulfed prehistoric mastodons

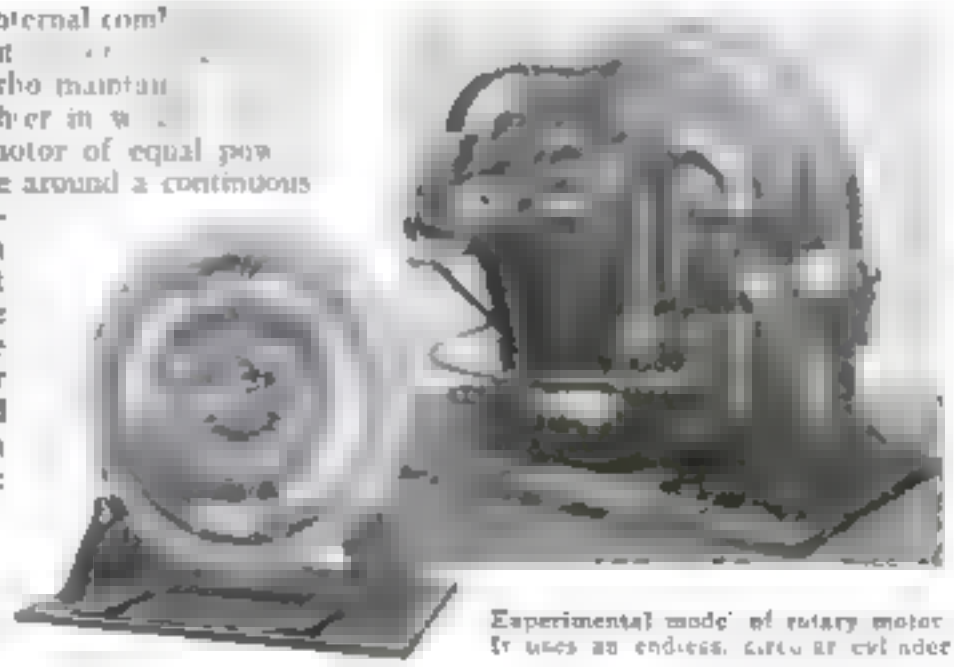


Test boring shows thickness of muck over hidden lake

How the Middle West looked at the close of the ice age may be seen near Urbana, Ohio. Shrubby cinquefoil, dominant plant of the post-glacial era, still covers an area of several acres where history apparently has stood still, and a state vegetational survey has just shown why. Beneath a thin surface layer of muck and roots, deceptively firm to the tread, test borings reveal a subterranean lake formed by the melting ice sheet 30,000 to 40,000 years ago. Pure artesian water supply has preserved the lake and its prehistoric vegetation unchanged. The area is regarded as an example of the bogs that once trapped roaming mastodons.

NOVEL ENGINE RESEMBLES A DOUGHNUT

Unique among internal combustion engines is a "doughnut" motor invented by an Ohio inventor, who maintains it is far smaller and lighter in weight than a conventional-type motor of equal power. Traveling in a circle around a continuous cylinder, four pistons, working in pairs, transmit their driving force through cams to the drive shaft. One pair of pistons is locked at the moment an explosion impels the other.

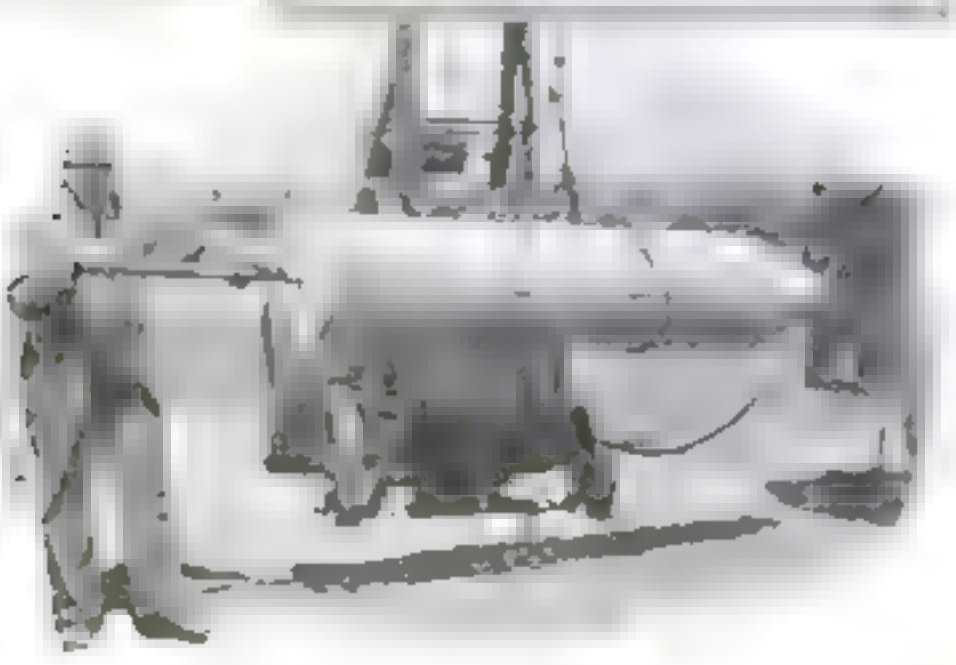


New rotary motor disassembled to show the pistons and cylinder

Experimental model of rotary motor. It uses an endless, circular cylinder

RELEASING THE BOMB

HOW HITS ARE RECORDED



BOMBLESS Bombing

Trains Army Flyers

SIX tiny model airplanes, poised only a foot above the surface of a table, teach bombardment pilots of the U. S. Army Air Corps to fly in intricate bombing formations. In other exercises, radio impulses take the place of 2,000-pound bombs in training bombardiers to drop their deadly missiles accurately upon targets a mile and a half below them.

Mounted on stiff spindles which are plugged into holes in a board, the models can be changed into a variety of formations. As an experienced instructor moves the six tiny ships through various evolutions, he explains to the young pilots the exact position for each plane during every movement. Thus they see, without endangering themselves, how tight formations should be flown, and learn the correct positions for individual planes before, during, and after a signal by the leader for a change in formation.

Bombing, like all military flying, is much more complicated than merely piloting a lone plane across the countryside. Since each pilot is permitted only thirty-two bombs each year for practice, and another thirty-two for recorded flights, a supplementary method for developing skill in laying steel "eggs" on a 200-foot bull's-eye from 250-mile-an-hour bombers has been worked out recently by Air Corps officers. By this means, pilots and bombardiers become so proficient that they can score at least seventy-five percent direct hits while approaching targets against or across the wind at altitudes of 5,000 to 8,000 feet. Recently so successful has the scheme proved, the majority of scores have ranged between eighty-five and ninety-five percent.

While the actual bomb dropping requires only eight flights for each bombardier annually, his schooling covers several months. First, he practices dropping theoretical bombs on an indoor range, a strip of canvas painted to represent towns, bridges, and open country. When he becomes familiar with the method of dropping bombs, he goes into the air. With his exact position registered in a camera obscura on the ground, he releases radio impulses to represent bombs, and "hits" are accurately recorded.

As the bombing planes roar through the air, the leader signals a change from V-formation into a single line. "Number two plane will drop bomb first time over," he orders. As the formation approaches, the bombardier sitting intent in the belly of the big monoplane, adjusts his bomb sights for altitude, wind direction and velocity and direction of the plane. He sees below and ahead the 200-foot circle of the target, and in its center a hut in whose roof is a lens which projects the image of his plane on a chart. Beside the chart stands a scorer, who is busy tracing the progress of the plane by pencil marks. On the paper too is a point which represents the hut or the target.

On through the sky roar the bombers. "Turn left," orders the bombardier to his pilot through the plane's interphone system. "Stop . . . . steady . . . . right . . . . stop . . . . *steady* . . . ." Now the cross hairs on his sight indicate that the time has come to release a bomb. Instead of pulling the bomb release, he touches a button which sends a single radio signal leaping down through space.

When the "dash" buzzes in his earphones, the scorer looks at his chronometer, then continues plotting the direction of the plane's flight for twenty-three seconds, the

LEARNING BY THEORY AND PRACTICE

At the left, young pilots are being taught how to fly in bomb [illegible] ... the making of [illegible] ... Below [illegible] Army bomb [illegible]

time required for a bomb to drop 8,000 feet. At the end of that time he marks with an X the point on the chart where he sees the plane's image. If the bombardier has scored a bullseye that cross will be marked directly on the dot representing the roof of the shack. Re[illegible] where the signal "strikes," however, th[illegible]

[illegible]

Of course, radio signals cannot altogether take the place of experience in actually dropping bombs, particularly the big destructive ones. Since every one-ton live bomb cost several hundred dollars, six-foot dummy bombs made of concrete are sometimes dropped during practice runs. [illegible] with vanes, they fly as accurately toward their ob[illegible]

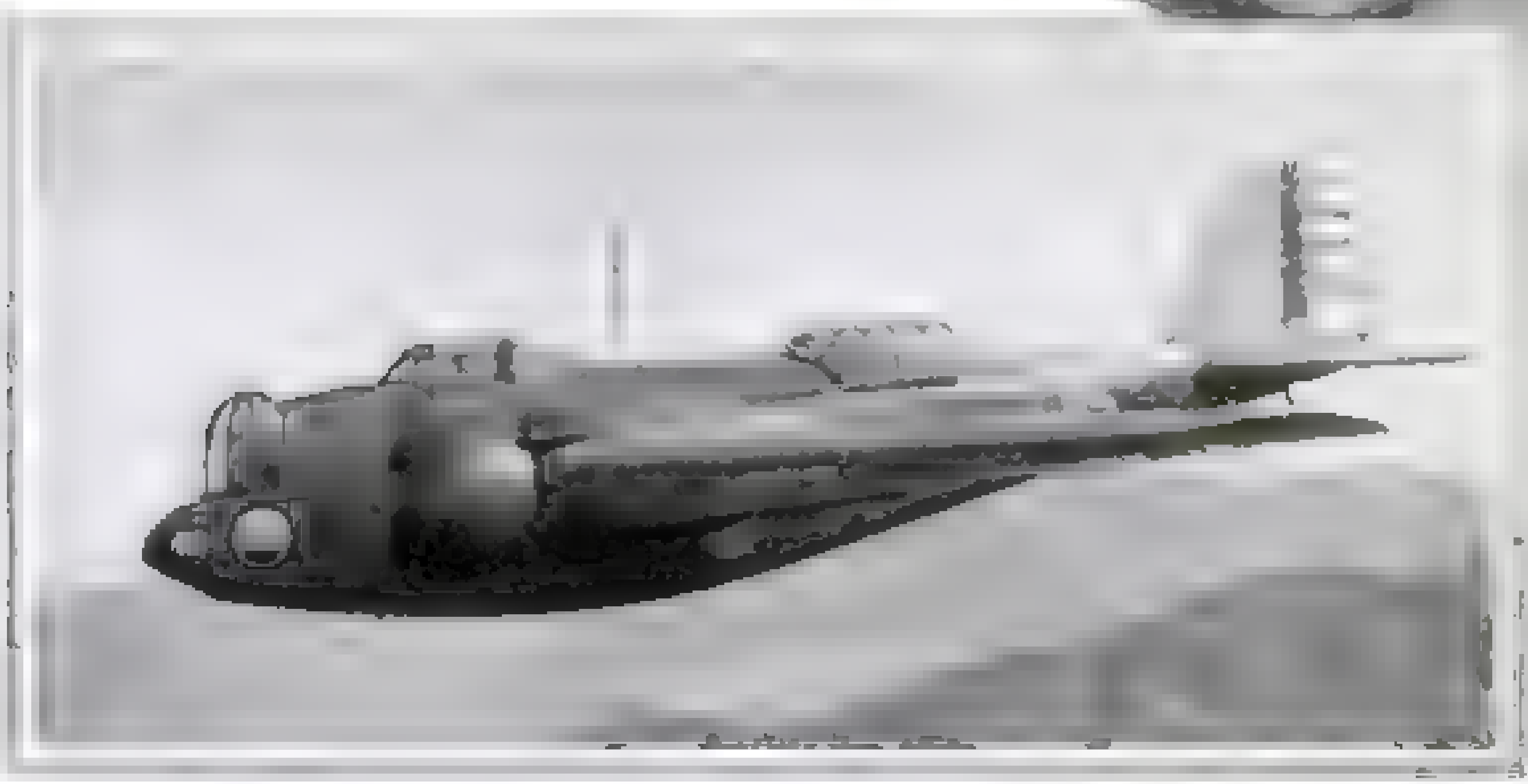
[illegible]

Re[illegible]

[illegible] ties of bombing [illegible] have been dropping short fuse bombs on ground ta[illegible] Perhaps the next step will be larger bombs which will blow from the sky any plane within a radius of several hund[illegible] feet. Not even six machine gun[illegible]

[illegible]

Sand-filled bombs [illegible] target work they are [illegible]



One of the Air Corps [illegible] gunners and bombardiers from blasts of air. The plane is protected on all sides by machine guns firing from the turrets

Boy Sailors Get Real

The barkentine *Norden*, recently acquired as a training ship for the American Nautical Cadets, at her berth in Brooklyn, N. Y. The vessel is being remodeled for its new use

Cadets inspecting the foremast rigging of their new club house

ON THE rolling decks of an old oak-timbered barkentine hundreds of American boys will realize their dreams of voyaging to the picturesque and colorful ports of the Spanish Main. During the long winter months between cruises, the vessel will provide a unique club house where the youngsters can receive nautical training and indulge their natural love of the sea.

Already scores of young enthusiasts are devoting their spare time—evenings, week-ends, and holidays—to fitting up their seagoing headquarters. At her berth on the waterfront of Brooklyn, N. Y., the fifty year old sailing ship *Norden* is the scene of bustling activity as energetic crews scrape rails and spars, caulk weather-beaten decks, and swarm through rigging that towers more than 100 feet above the water.

This unusual experiment is the work of the American Nautical Cadets, a new organization which already numbers 700 boys in its membership. Among its leaders are old-time sea captains, Navy, Coast Guard, and merchant-ship officers, marine artists, and writers about the sea. Its purpose, as announced at the time of its organization a year ago, is to foster good fellowship and provide disciplined training for older boys who have outgrown the activities of younger boys' clubs.

The project aroused immediate interest not only among the boys, but also among shipping men and other lovers of the sea. The advisory council includes veterans of sail such as Capt. Bob Bartlett, Capt. Felix Riesenberg, and Admiral George H. Rock. Other members of the council are Prof. William Hovgaard, Admiral Frederic R. Harris, Gordon Grant, Warren Sheppard, Eads Johnson, Capt. George Fried, Capt. Thomas Molloy, and Capt. E. Armitage McCann. Captain McCann is known to readers of POPULAR SCIENCE MONTHLY as the designer of many ship models.

The *Norden*, first training ship of the organiza-

A class in small-boat construction. While their ship is being made ready for the sea, members of the organization are receiving training in the theory of navigation, chart reading, weather forecasting, and ship maneuvering, as well as in seamen's duties

Ship for Club House

A boy sailor learning to "shoot the sun" with the sextant. Yachtsmen, former seamen, and marine artists serve as instructors for the young members

Manning the windlass to hoist the *Norden's* mainsail. The fifty year old ship is a barkentine, square-rigged on her foremast and fore-and-aft on main and mizzen

LEARNING THE A B C's OF GOING TO SEA

In the center picture, a cadet is taking his trick at the wheel, while his shipmates look on. Above, an instructor initiating a class into the mysteries of the ship's compass. Boys will man the vessel on cruises to Bermuda and the West Indies

tion is a 120-foot barkentine square-rigged on the foremast and fore-and-aft rigged on the main and mizzen. She was built in Denmark in 1883 and is a veteran of arctic expeditions, whale and seal fishing, and the lumber trade

To transform the vessel into a floating club house, the cramped forecastle and officers' quarters are being enlarged. Between decks, a part of the hold is being partitioned off to provide a meeting room for winter use and sleeping quarters for a large crew when the ship is at sea. A steam heating plant is about to replace the two tiny stoves that formerly heated the living quarters fore and aft, and electricity will supplant the old oil lamps

Even while construction is going on, the boys are being trained to handle their ship when she sets sail for cruises on Long Island Sound, or to Bermuda or the West Indies. Classes in the theory of navigation, chart reading, signaling, weather forecasting, and ship maneuvering, as well as in the practical work of handling lines and sails, climbing aloft, and handling small boats, are all part of the weekly routine

INTEREST in the American Nautical Cadets indicates that the *Norden* will be only the first of a fleet of such seagoing club houses, with vessels located at all the important seaport cities in the country. Already, additional shore units have been established in other boroughs of Greater New York, and applications have been received for permission to found divisions in New Jersey and in distant parts of Long Island.

Requirements for membership are a minimum age of sixteen, good health, and the ability to work hard. Needless to say, the applicant is also expected to have an interest in ships, and in everything connected with them

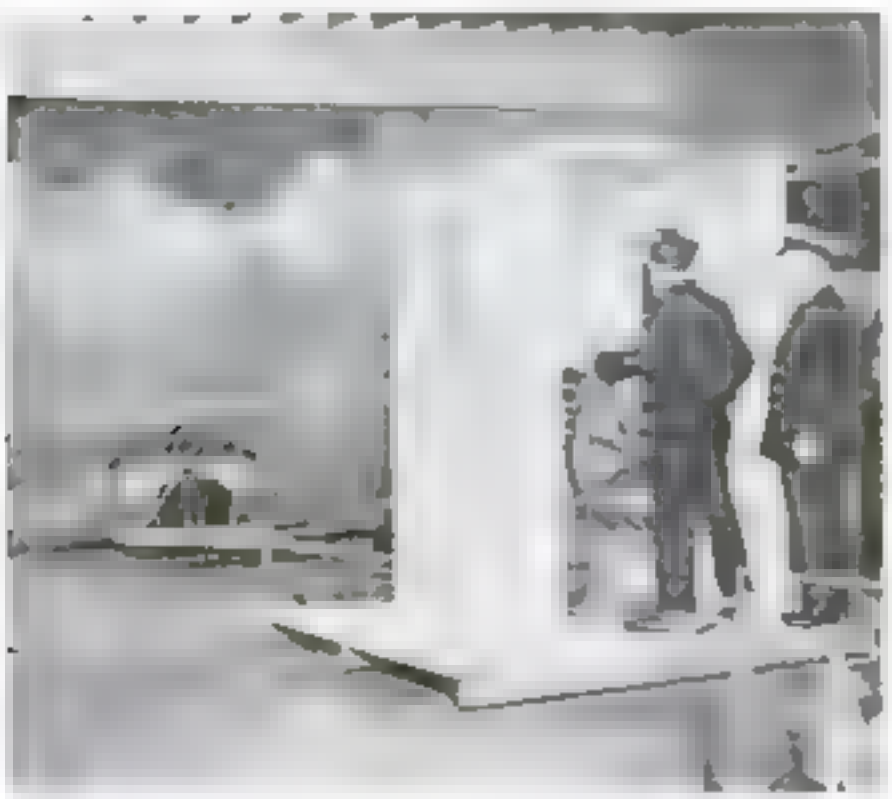
Perhaps the sailing ship, no longer efficient as a commercial carrier, may find new usefulness in building healthy bodies and alert minds, and in keeping alive in young Americans the traditions of seamanship that once made American clipper ships leaders in the commerce of the seven seas

Giant Rockets To Explore Stratosphere

From this tower near Roswell, N. Mex. Dr. R. H. Goddard will send rockets into the stratosphere. Right, the experimenter and assistants with one of the rockets

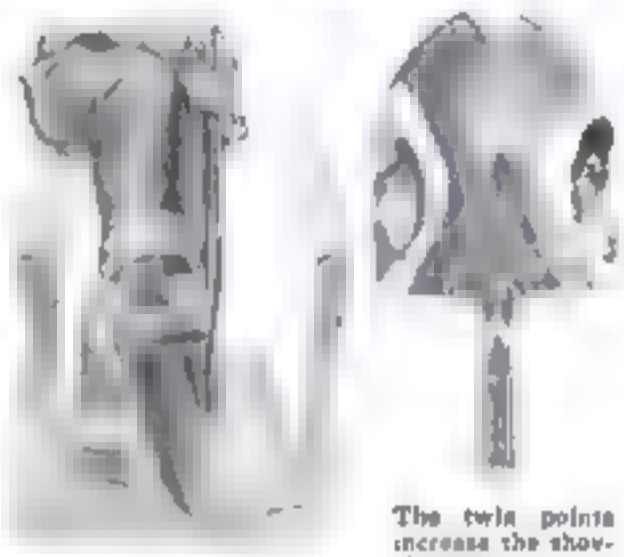
From a sixty-foot tower at his desert laboratory near Roswell, N. Mex., Prof. Robert H. Goddard of Clark University plans soon to launch giant rockets into unexplored regions of the atmosphere between twenty and 150 miles above the earth. Carrying automatic recording instruments, and descending on parachutes, the rockets will bring back invaluable scientific data, including information on high-altitude electrical conditions that affect radio transmission. After a recent visit to the laboratory, Col. Charles A. Lindbergh reported favorably on the work, assuring continuation of the experiments.

SAILORS TRAIN IN DUMMY WHEELHOUSE



Dummy pilot house used in training helmsmen for British ships

A DUMMY wheelhouse, swinging in an arc to imitate the maneuvers of a ship at sea, teaches future sailors of the British merchant marine the rudiments of a helmsman's duties. The device, used at the Gravesend Sea School, is made more realistic by a painted foreground representing the bow of a ship with the sea beyond it—the scene the student will have before him when he actually takes the wheel on his assigned ship. Under the guidance of instructing officers, he puts his "ship" through all of its maneuvers



The twin points increase the shovel's cutting power

SHOVEL HAS TWIN POINTS

MADE with a V-shaped cut at the tip, giving it twin points, the shovel pictured above is claimed by its inventor to be more efficient and useful than the conventional types on the market. Its increased cutting edge at the tip makes it easier to penetrate the soil and the V-shaped notch acts as a cutting tool when roots are met.

NEW-TYPE HOUSE HAS WALLS OF COPPER

FIRST of its type in America, a "copper house" just completed in a suburb of Washington, D. C., is expected by its builders to set a new style in construction. Exterior walls consist of heavy copper plates, backed by composition board and mounted on a framework of structural steel. Sheet copper, over a wooden deck, forms the roof. All the plumbing pipes in the house are of nonrustable copper tubing, and heating lines, radiators, and hardware are also of copper or copper alloys.

WINDMILL PUMPS AIR FOR AUTO SERVICE STATION

By tapping the breezes for power, a Florida inventor has found a way to provide automobile service stations with an economical supply of compressed air. Driven by an eight-foot wind vane, his unit stores air under pressure in a capacious tank and provides a sufficient supply not only for inflating tires but also for running air-operated grease guns and pneumatic lifts. The picture above shows a windmill in operation which maintains a pressure of 140 pounds a square inch.

CHILD IS CALLED HOME BY RADIO

Wherever she goes, five-year-old Jean Darlington of Scotia, N. Y., is always within call of her parents, for she trundles with her a small, portable short-wave radio receiver. When it is time for her to start home, her father steps to his transmitter and the child's receiver, permanently tuned to his amateur station, relays his instructions. Another electrical innovation in the Darlington home is a remote-controlled phonograph, installed in Jean's bedroom when she was several years younger. When she awoke and cried during the night, her father could quiet her without rising, simply by touching a bedside switch that started the phonograph playing a record of a soothing lullaby.

Talking in to his amateur transmitter, this father calls his daughter from play. The child, seen at left, always has her portable receiver with her

FISH RACING IS LATEST SPORT FAD

Individual troughs for fish races, and starting boxes from which the contestants are released

Fish races are a new fad at Depoe Bay, Oregon, where a recent contest is reported to have attracted hundreds of spectators. When the starter turns a crank, the fish are dumped simultaneously from triangular starting boxes into separate troughs. They swim rapidly toward the far ends of the troughs, where deepening water and dark-painted walls offer comparative concealment, and the first fish to reach the finish line trips a device that throws up a flag to designate the number of the winner. The bottoms of the troughs are painted white, making the progress of the fish easy to follow. Rock cod are said to have proved the best racers.

INVENTOR DEMONSTRATES NEW FOG-PIERCING EYE

As a further development of his "magic eye" for detecting ships, airplanes, and other objects hidden in fog (P. S. M., July '33, p. 42) Commander Paul H. Macneil recently demonstrated the simplified apparatus illustrated above. Invisible rays, emanating from objects which are either warmer or cooler than their surroundings, are detected by a photo-electric cell and a steady buzzing heard in earphones attached to the device is interrupted. With this "eye," it is said, ships could proceed safely through fog at regular speed.

A metal disk dropped in the slot opens the lock

DISK REPLACES KEY FOR OPENING NEW LOCK

Instead of turning a key to open this novel lock, you drop a metal disk in a slot, the lock is released, and the disk drops out. The novel key is a little steel disk about the size of a nickel, and each lock has a different design. The disk unlike a key, does not have to be fitted into a grooved lock opening but is simply dropped into a slot and in this way eliminates fumbling in the dark. This type of lock, it is claimed by the inventor, is also much harder to pick than any of the conventional types now on the market.

GETS RARE CLOSE-UPS IN TINY AQUARIUM

Using [illegible] tiny homemade aquarium to hold his subjects, a Californian has de-[illegible] [illegible]cessful means for taking [illegible] [illegible]derwater pictures of rare [illegible] [illegible] plat[illegible] These th[illegible]n w[illegible] [illegible]minate the [illegible] which are [illegible] [illegible] The dim[illegible] [illegible] of the aquarium [illegible] [illegible] [illegible]ches and two and one half inches wide [illegible]estricts the movements of the sub[illegible] No special camera equipment is needed

[illegible]

AIRPLANE PROPELLER IS BIGGEST NOISE MAKER

Tests at Langley Field, Va., have shown, according to a report of the investigators, that a two-bladed airplane propeller radiates more noise, expressed in watts of power, than does almost any other continuously operating device. The exceptions are certain signaling devices. The test motor and propeller, as seen in the above photograph, were 235 feet from the nearest obstruction.

LIFE LINE HAS SPRING TO EASE WORKER'S FALL

In order to ease the sudden drop of a workman in case of an accidental fall from a height, General Electric engineers have added a shock-absorber spring to the far end of his life line. The spring is fastened to the life line so that there is a twenty-four inch loop of rope between its ends. This arrangement, it is stated, checks gradually the descent of the workman and brings his fall to a gentle stop. The engineers have also devised a special safety harness, as shown above, which is made of webbing instead of leather and is said to be 100 per cent stronger than the usual safety harness material.

NOVEL DOCKS OFFSET GIANT TIDES

Towering wharves with a special wooden platform lining the bed of the docking space are the means shipping men have taken to counteract the phenomenal tides of the inland waters of Nova Scotia and New Brunswick (P. S. M., Aug. '35, p. 9). Huge freighters, moored in such docks when the tide has ebbed, stand with only a puddle of water under them but they rest firmly on a flooring of wooden beams. The vessel is held upright in such a "dry dock" not only because of its mooring lines but also because it has been ballasted with a slight list to port or starboard, depending on the relative position of its wharf.

A few hours after a ship has been standing high and dry in its dock, it may be floating in thirty feet or more of water, such is the tidal rise in this area. Ferries which ply these waters must also contend with the unusual tides. They run on a schedule which may be summed up in the words, "According to the tides." For example, a ferry leaving Kingsport, Nova Scotia, on a high tide for the run across the Bay of Fundy to Parrsboro may reach its destination just in time to slip into the dock before the fast receding waters ground her

Ships moored at Bay of Fundy wharves are ballasted so they will lean against the dock and not tip over when the giant tide recedes

The Man with the Net

NORTH AMERICAN CARIBOU *migrate as much as 800 miles in a year.*

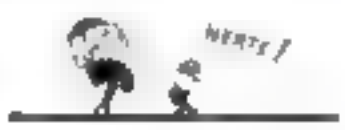
BEES *are more sensitive than human beings to the taste of salt.*

BANANA TREES *are not trees. They are herbs.*

TIDES *at the Pacific end of the Panama Canal are six times as high as they are at the Atlantic end.*

HUMAN EYES *make from three to twelve hops in reading a line of type and they go blind for about one fifth of a second between hops.*

WOMEN, *according to psychological tests, possess more ego than men.*



SANTA CLAUS, IND., *is erecting a monument to Santa Claus.*

METEORITES *supplied Eskimos with iron for primitive knives and daggers.*

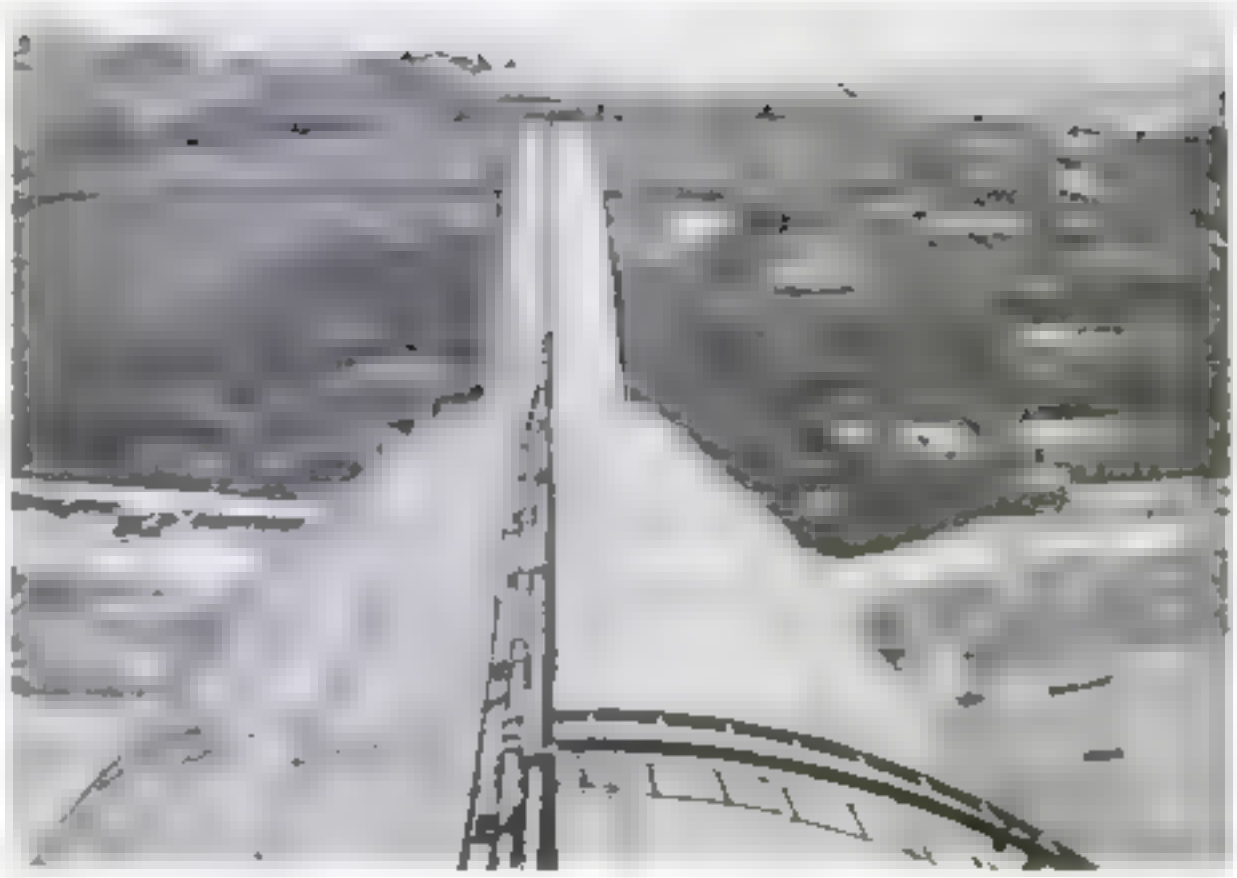
GOLF GREENS *are air-conditioned by a new apparatus designed by a Washington, D. C., inventor.*

MOUNTAINEERS *in North Carolina are the tallest group of people in the United States.*

MODEL AIRPLANES, *with rubber-band motors and propellers, were known in France as early as 1871.*

MEASUREMENTS *show the Sahara Desert is spreading southward at the rate of more than half a mile a year.*

SWAN ROUNDUPS *are an annual event on the Thames River in England. Young birds are caught and "branded" with distinguishing marks cut on their bills.*



BRIDGE TURNS MONSTER IN ODD VIEW

Looking like some prehistoric monster crawling over the countryside, the Royal Albert Bridge at Saltash, England, assumes an odd appearance in the photograph reproduced above. The two main, upper supporting spans of this unusual structure are elliptical wrought iron tubes, each 255 feet in length. Girders which carry the roadway below are suspended from these huge arching tubes. The bridge has been used for a great many years by the Great Western Railway to cross the River Tamar where it separates the counties of Devon and Cornwall.

MUSICIAN BUILDS COPY OF OLD EGYPTIAN HARP

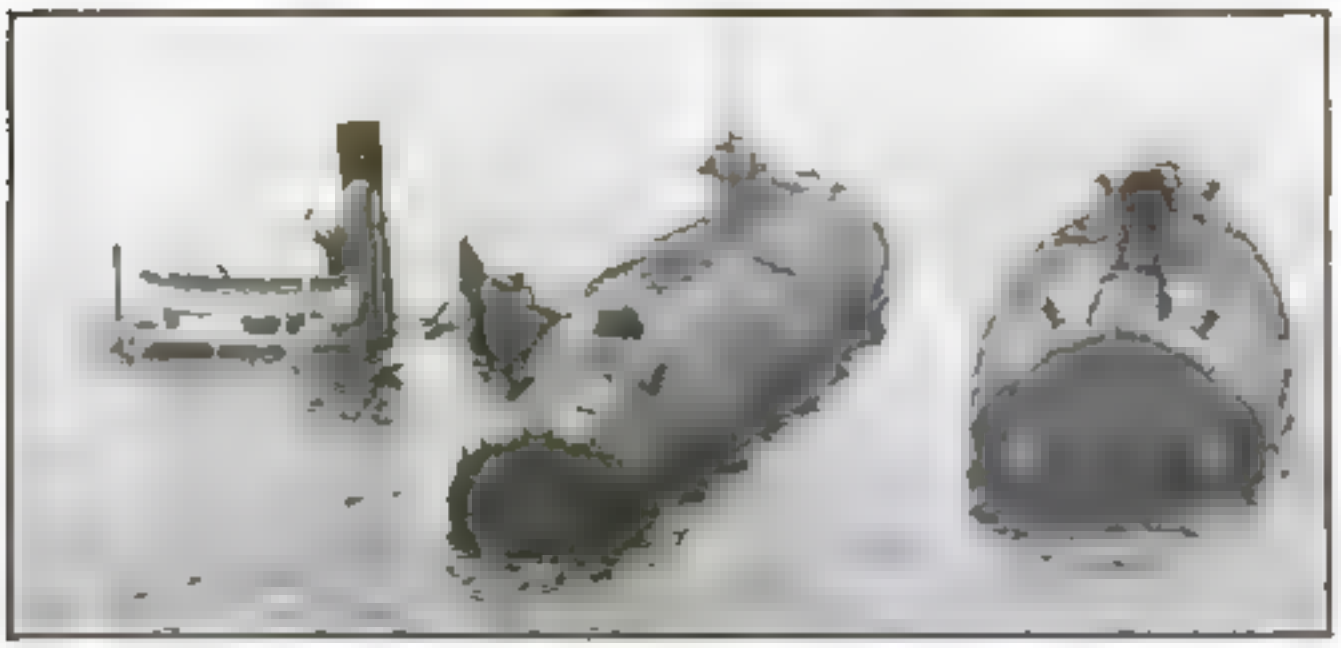
A copy of a harp which was probably played at the court of King Tutankhamen, has been built by C. Belmont Hendricks, a Philadelphia, Pa., musician. The original instrument was taken from the tomb of King Tutankhamen and is now in the British Museum. It is classified as a Chaldean harp and is tuned in the pentatonic, or five-tone scale. Records show these harps were played in Egypt and Chaldea as far back as 1500 B.C. Very few of such ancient stringed instruments have been recovered by archaeologists.

MOLDING KIT IS WORKSHOP FOUNDRY

A miniature foundry set for the workshop makes molding items at home easy

A COMPACT metal-casting kit, including gas furnace with motor blower attached crucibles, tongs, flask, and sand, enables the home craftsman to have a miniature foundry in his workshop. Any of the casting metals may be used to mold ornamental articles or metal parts needed in construction and repair work. The furnace is obtainable in two sizes.

JUNKED SUBMARINES USED AS PONTOONS IN SALVAGE JOB

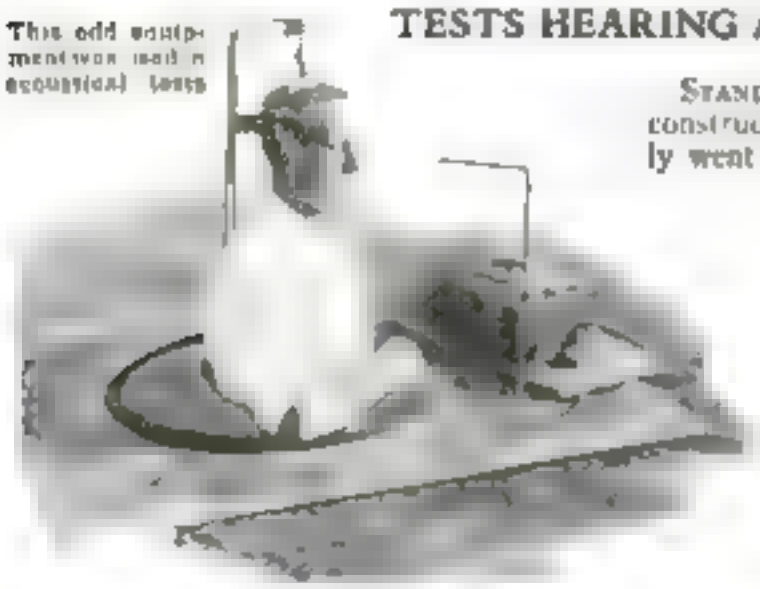


Salvagers maneuvering two scrapped submarines into position for use as pontoons in raising a vessel

BRITISH salvagers added a new stunt to their bag of tricks, the other day, by raising a sunken vessel with the aid of submarines. Sent to the bottom by a collision the steamer *Errol*, lying half submerged, constituted a menace to navigation in the Firth of Forth Scotland. Seeking a means of refloating the craft, the salvagers obtained the hulls of two obsolete dismantled British submersibles and used them as pontoons. With the undersea boats lashed to its sides and made buoyant by "blowing" the ballast tanks, the *Errol* soon was lifted from its shallow resting place and towed to the seaport of Leith, where it was beached

TESTS HEARING AT VARIOUS ANGLES

This odd equipment was used in acoustical tests



STANDING waist-deep in an especially constructed manhole an engineer recently went through strange antics to obtain valuable sound data for acoustics research. Facing each point of the compass in turn, he moved a dial until a tone signal heard in one ear, through a telephone receiver, matched the apparent loudness of a distant loudspeaker heard with the other ear. The tests showed the response of the ear to sounds from various angles.

NEW TOOL IS BOTH PLIERS AND WRENCH

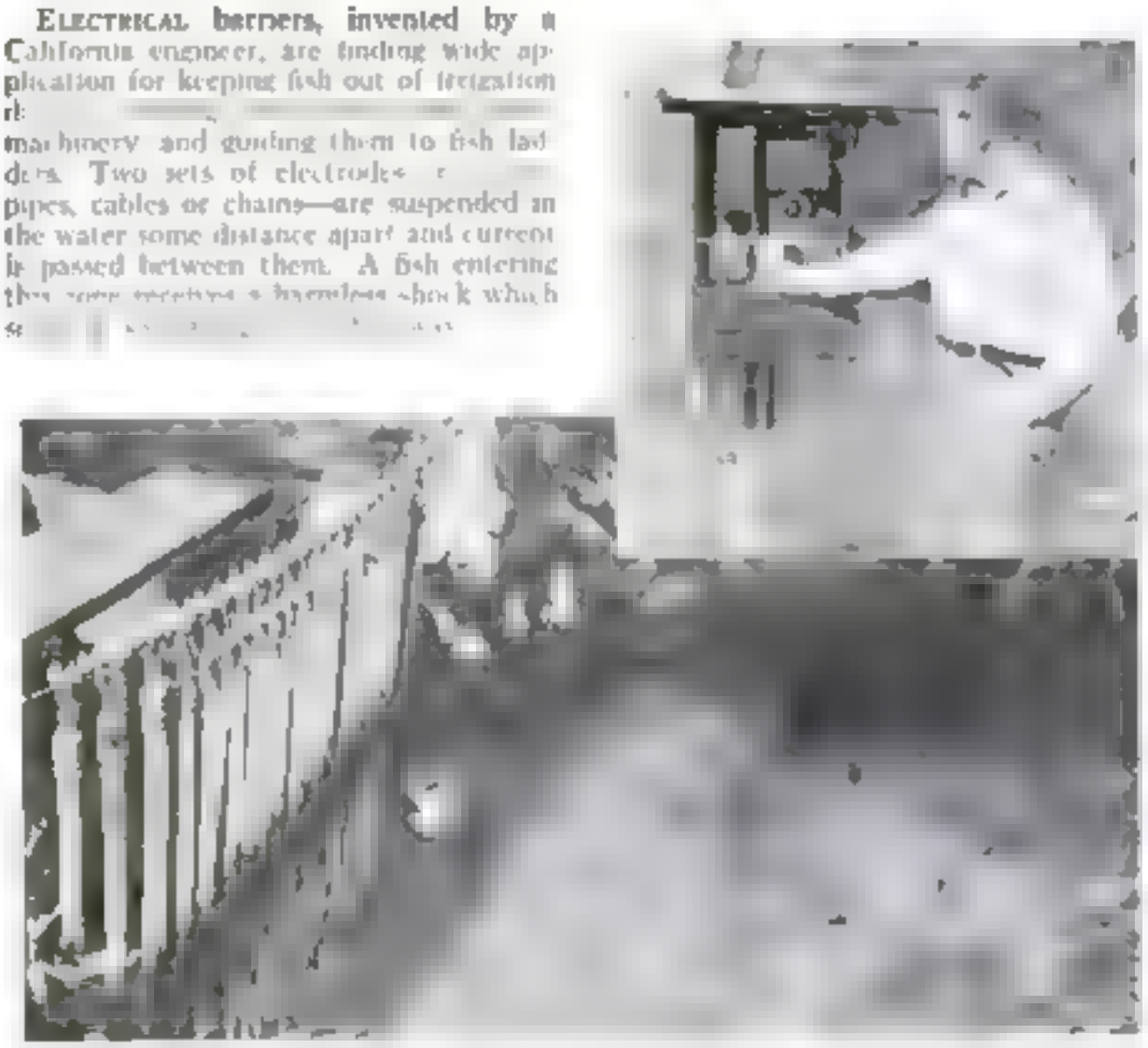
PLIERS and wrench are combined in a new tool. When an adjusting screw is turned until the jaws just slip over a piece of work, and a clamping lever is snapped shut, the jaws are locked upon the work with a vise-like grip and will not let go until the lever is released. The tool may also be used in the manner of ordinary pliers.

NOVEL WIND INSTRUMENT IS PLAYED LIKE A PIANO

PLAYED with a keyboard like that of a piano, a curious wind instrument devised by a German musician presents a striking contrast with the intricate design of conventional types of horns. Organlike tones are evoked by blowing into a mouthpiece mounted upon a tube above the instrument, while the desired notes are simultaneously fingered, as shown in the photograph above. The unusual design of the instrument is declared to make it relatively easy to master

BARRIER OF ELECTRICITY STOPS FISH

ELECTRICAL barriers, invented by a California engineer, are finding wide application for keeping fish out of irrigation ri[illegible] machinery and guiding them to fish ladders. Two sets of electrodes [illegible] pipes, cables or chains—are suspended in the water some distance apart and current is passed between them. A fish entering this zone receives a harmless shock which s[illegible]



Two rows of electrodes, with current passing between them, create a barrier through which fish will not pass. Inset shows the simple control panel that regulates the current for the barrier

CALIFORNIA PREPARES FOR A GOLDEN FLOOD

Scenes like the one at the left, taken during the hydraulic-mining boom in the early 80's, will be reenacted soon in California. Four proposed dams will again make it possible for miners to wash gold from High Sierra gravel banks with high-pressure water from huge monitors

A Billion in Gold

To Be Recovered by Hydraulic Mining

ONCE again the silence of the High Sierras in California will be broken by the roar of giant nozzles spouting high-pressure streams of water against gravel banks that are rich in gold. This buried treasure, abandoned fifty years ago when hydraulic mining was forbidden, is expected to yield a billion dollars.

After the placer miners had skimmed off much of the cream in the years following the gold rush of '49, hydraulic mining was developed to extract the "dust" and "flour gold" from the sand and gravel of river banks and hills. For twenty years the big nozzles, or monitors, hissed and roared. Hilltops were washed away and high banks melted under the withering attack of the high-power streams.

In this washing-away process, however, the waste material—sand, gravel, and silt—was carried downstream to find its way into and obstruct the Sacramento River and its tributaries. As a result, a law was passed in 1884 forbidding the free run-off of tailings in the area drained by the Sacramento River. This was a death sentence for the high-pressure monitors. They have been quiet ever since. Many of the workings now bear a sturdy stand of second-growth timber, while others remain as they were left fifty years ago.

Today these forsaken hills are about to receive a new lease of life. U. S. Army engineers have approved a plan for reviving the old hydraulic workings without affecting the navigability of the river or its usefulness for irrigation.

The plan calls for the building of four dams; one each on the Yuba River, the Bear River, and the north and middle forks of the American River. The dams will hold back the water containing the hydraulic waste washings until the silt has settled and then allow the clear water to flow into the Sacramento Valley.

Present-day hydraulic equipment, whose prototype was a stitched-cowhide hose and a cow-horn nozzle, sends forth water under pressures up to 200 pounds per square inch. The gravel which it loosens is led into long flumes, the bottoms of which are fitted with riffles or transverse bars of wood. Behind these riffles is lodged mercury. The gold specks, both because of their weight and their affinity for mercury, settle to the bottom and are trapped by the riffles.

Dams on the Yuba, Bear, and American Rivers will keep the Sacramento River free from hydraulic-waste washings

Danger to life and property always lurked around "hydro diggin's." With two high-power streams of water gnawing at a gravel bank weighing hundreds of tons, it required a sixth sense to know just when to move the big monitors to avoid being crushed under a ponderous cave-in. These powerful streams rolled huge bowlders about as a garden rake would scatter pebbles. And then the streams, themselves, sometimes got out of control with casualties to the operating crew. At La Porte, the lives of an entire crew were snuffed out at one time in this manner.

Up to the time the "hydraulickers" were obliged to quit, it is estimated that they moved a mass of earth equal to a strip of land thirty miles long, one mile wide, and fifteen yards deep and from it had extracted $500,000,000 in gold dust. They were forced to stop with hundreds of millions of dollars more in treasure right in front of them!

But now resumption of their task appears to be near at hand. The roar of the high-power monitor will again resound in the High Sierra country and the historic Mother Lode region will once more allure with the age-old call of gold.

Color Wizards Identify

A highly trained color tester judging skeins [illegible]

HUMAN COLOR METERS AT WORK

In the photograph [illegible] are be- [illegible]

[illegible]

DID you ever hear some one [illegible] to be funny: "I don't care what color it is, just so it's white"? Such a remark might make you laugh or groan, depending on your sense of humor. But in the modern rainbow laboratory where there are men whose highly trained eyes can detect over 300 shades of white and nearly as many kinds of blacks, the intended wisecrack might be taken a bit seriously.

Such a rainbow laboratory stands at Deepwater Point, across the Delaware River from Wilmington, Del.: the Technical Laboratory of the Organic Chemicals Department of E. I. du Pont de Nemours & Company. There a staff of highly trained scientists and technical workers spend their time developing new dyes, working out new applications for existing dyes, and maintaining order among all the colors of the rainbow—and several thousand other colors and hues never found in any rainbow.

These color scientists work with highly specialized instruments—with spectrophotometers for measuring the wave length of light reflected or transmitted by a dye; with artificial weather machines which subject a dyed material, in a few hours, to as severe weathering as it normally would receive in months or years; with sensitive balances for weighing out exact quantities of dyes and test fabric or thread. But the most important job in the laboratory—the matching of colors to determine whether they come up to standard—is done by an instrument whose color-sensitive characteristics were developed millions of years ago—the human eye.

Science has been able to produce machines that are as sensitive to color differences as the human eye, in that they measure the stimulus we know as color with equal delicacy. But these machines do not give their readings in terms of

By
WALTER E. BURTON

physiological response which, after all, is the chief thing about color that interests you and other humans.

A well-trained eye, according to Dr. R. E. Rose, director of the laboratory, can recognize something like 100,000 different hues and colors. If, to a batch of yellow dye, one twenty-thousandth as much red dye as yellow is added, such an eye can detect it!

BUT your eyes could not respond to such fine degrees of color stimulation, simply because they have not had the proper training. Whenever Dr. Rose needs a new color standardizer, he goes out and gets an eighteen-year-old boy, who has just finished high school. He then proceeds to convert him into a man who is qualified to serve as a kind of referee in the game of imitating rainbows and making life more colorful for every one of us.

The boy's first step towards becoming an efficient color meter is to gaze at cards containing circular patterns made up of colored dots of various sizes. These dots are arranged so that those of each color form a definite pattern. Thus, blue dots scattered through a maze of red dots might form the figure [illegible] form a [illegible] path between two X's placed at opposite sides of the pattern.

If the boy's eyes are normal, he will be able to see the various figures or other patterns, no matter what the colors are. But if he is partly color-blind, he will fail to see some of the figures. Thus the blue figure in a certain disk might be very plain to him, while the red figure in the same disk would be invisible against the gray background, indicating that his eyes lacked red sensitivity. If he is wholly color-blind, all colors will look gray to him. This set of test cards forms the widely used system of color-vision testing, devised by a Japanese scientist, Dr. S. Ishihara.

Of course, a completely color-blind young man stands no chance of becoming a color expert, because he cannot tell one color from another. If he is weak in one color—if, for instance, he cannot distinguish all shades of red—he still might become a useful color expert, but not as good as a person with normal vision.

After the color-expert candidate passes the Ishihara test, he is turned loose for a time among an assortment of colors. Samples of colored cloth, yarn, and other materials are given to him. He is asked to look at them, study them, but for the present to do nothing more about them. This is to get him accustomed to seeing hundreds of different colors. Later he is asked to identify certain colors and hues by name.

As the training continues, the young man learns to recognize most of the colors

100,000 Hues by Eye

produced by Du Pont dyes. This amounts to more than merely recognizing the dye itself, for a single solution may produce a different hue with each different material. He becomes familiar with dyes used for coloring leather, wood, cloth, and scores of other materials. Then he has to learn to identify most of the colors produced by competing dye manufacturers.

In five or six years the eyes of the apprentice may become so sensitive that he can work alone, comparing colors to determine whether they are up to standard. Before that time, he does more and more standardizing, as his skill grows; but always there is an experienced color man to check his results.

The skill it is possible to develop in the normal human eye is amazing. The ordinary man is able to distinguish several dozen colors and hues, all those necessary for carrying on his daily work and recreation. The chances are that his wife can recognize colors that he does not see simply because she has had more experience in matching thread, picking out dress goods, and otherwise working with finer hues all her life. In other words, her eyes are better trained than his.

Suppose you visit one of these color experts while he is at work. You may find him in a laboratory where a dozen or so workers are engaged in cooking

A spectrophotometer, an instrument used to measure the wave length of light reflected or transmitted by a dye

This machine makes up bows of dyed yarn for use as samples to illustrate the various dyes manufactured

skeins of rayon yarn in dye baths, rinsing them, and otherwise treating them to produce the color desired. Perhaps a manufacturer has ordered some black dye, and he wants it to match a standard he has for reference. It is necessary to test the lot of dye carefully before shipping it to the customer, to make sure that it will produce a color exactly like the standard or sample.

And so a black dye test is being run. There, on a table in front of a north window, are a dozen skeins of black yarn— all of the same kind of black to your eyes. But the color expert, whose eyes have received years of training in recognizing colors, walks over to the table. He picks up several skeins, and holds them side by side in his hands. Rapidly he sorts them, placing them in several groups.

"This black has too much red in it," he tells you, as he lays a skein on the table. "Here are a couple on the dull side, and here are some that are too green."

And so he continues to compare and sort blacks that all look alike to you, until he finds a specimen that matches the color of the standard which the laboratory has for reference.

Artificial light is not very popular in the color laboratory. All judging of color is done by daylight, preferably that coming through a north window. The color expert will work until the daylight becomes too dim to permit accurate results, before he will turn on the electric lamps. Special bulbs and filters producing light of daylight quality are employed when artificial illumination is necessary.

There are three ways in which a color may vary from standard, and it is on this basis that the important job of color matching is carried out. First, the color may be stronger or weaker than the standard. It may still be the same color in other respects, but may be present in too low or too high a concentration. Variation in strength of the dye solution may remedy this. Second, the hue may lie on one side or the other of the standard. That is, a certain red may be too yellow or too blue, or a certain yellow may be too green or too red. Third, the color may be too dull or too bright. Brightness of a color has nothing to do with its strength, although the untrained eye might have difficulty differentiating the two properties.

If you hand a color expert a piece of dyed cloth and ask him if it is the same color as a sample he saw yesterday, he will hand it back (Continued on page 114)

Queer Facts about COLOR

There are sensitive scientific instruments for measuring color stimuli, but the human eye is the best testing device for determining physiological response to color.

If, to a batch of yellow dye, one twenty-thousandth as much red as yellow is added, a trained color expert can detect it.

Color-blindness is most common among white males, about six percent being insensitive to reds or greens or both, and two percent more, partly so.

Women are rarely color-blind.

Women generally are better judges of color than men, because they pay more attention to color.

Every piece of paper sold today is dyed. Paper is made whiter by the addition of dyes.

Color experts can recognize more than one shades of white, and nearly as many different blacks.

The most widely used dye is sulphur black.

Repeal of prohibition created a demand for alcohol-proof red dyes.

"Purple" is a word never heard in a modern color laboratory. The color experts say "red-blue" or "red-violet" instead.

The best dyes in the world are made in the United States.

Your Microscope Explains

By Observing the Action of Developers and Films, You Can Learn How to Improve Your Own Work In Making Photomicrographs and Ordinary Pictures

By MORTON C. WALLING

WHETHER or not you are an amateur photographer, you can spend a fascinating evening investigating the mysteries of photography with your microscope. As a by-product of such exploration, you will become more expert at making photomicrographs. Or, if you have not yet ventured into this exciting branch of microscopy, you will learn that it is not a difficult field, and that you need not spend a fortune for equipment in order to take pictures of the wonders you see through your instrument.

The light-sensitive part of a photographic film consists of one or more thin layers of gelatin containing silver bromide. This light-sensitive salt is in the form of very small grains, distributed throughout the film. Obtain a piece of old, light-struck film—almost any drug store or photographic dealer will have some out-dated film that he will give you—and examine it with your microscope. Even at 100 diameters you can see that the emulsion, as the gelatin-silver bromide mixture is called, has a grainy structure. To see the forms of individual grains distinctly requires 1,000 or so diameters magnification, but you can distinguish the grains plainly at much lower powers.

Cut a piece of film about the size of a cover glass, and lay it on a clean glass slide, under the lens of your microscope. Place on it a drop of diluted photographic developer, add a cover glass, and watch while the developer reduces the grains of light-struck silver bromide to spongy masses of metallic silver which, because of its finely divided state, is black.

In watching this bit of microchemistry, you are witnessing one of the most important processes of the modern world—the conversion of a chemical compound into one of its elements, in such a way that it forms a photographic image. If you could observe grains of silver bromide which had not been acted upon by light, you would find that the developer does not reduce them to metallic silver. Further observation would reveal that the extent of reduction depends on the amount of exposure to light.

Because development begins immediately, observe the action of the solution as soon as possible after it touches the film. Time can be saved by putting a drop of developer on the cover glass, inverting the glass, and placing it so that the hanging drop covers the film over an area within the field of view.

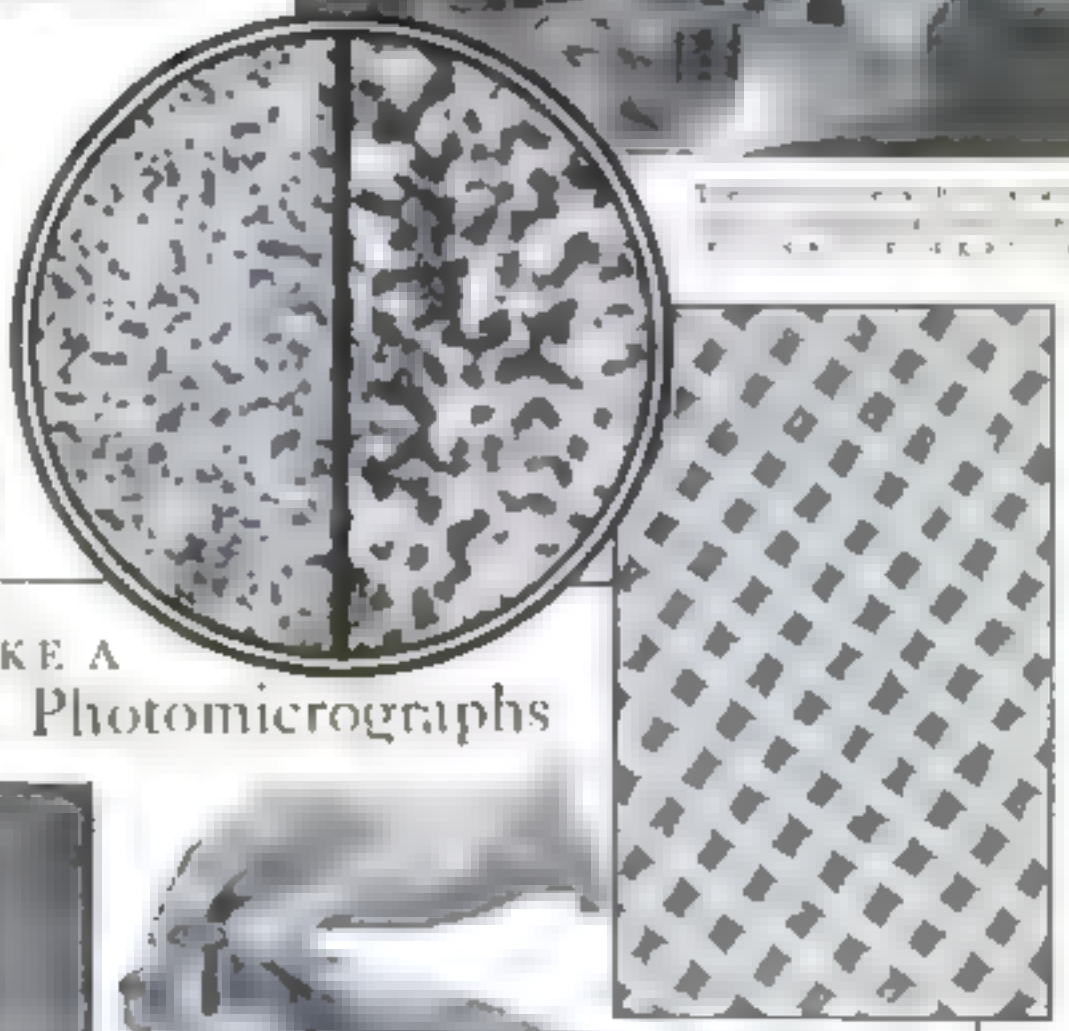
With a concentrated-beam light source, such as the 108-watt lamp described in a former article of this series (P. S. M., Sept. '34, p. 44), you can see very easily why photographers are likely to become gray-headed in hot weather or tropical climates. Focus the light beam until it forms a small, bright spot on the image plane. Then, placing on the slide a piece of film which is either developing or has been developed and wet with water, watch what happens. At 100 or so diameters you will see the mass of silver grains suddenly start moving. They flow about like sand grains in a swift stream, or like the insides of an amoeba. What is happening is simply this: The gelatin melts in the heat of the light beam, and starts flowing. The same thing happens in many a developing tank that is too warm, or in an enlarger when attempts are made to enlarge a wet negative.

Sometimes you will discover that some of the grains are moving, but that above them there is a layer remaining stationary. This indicates that you are looking at a double-coated film or plate, and that the gelatin of one layer has melted while that of another remains intact.

Mix an ounce of formaldehyde (the standard forty percent kind) in ten ounces of water, and put a piece of film in it for fifteen minutes. Now try to make the gelatin flow in the heat of the lamp. You find it impossible, or at least difficult. Thus you have discovered another important photographic trick: harden the gelatin of your films or plates with formaldehyde, before development if you wish, and you will not be bothered much by hot weather photographically speaking.

By concentrating an intense beam of light on a piece of wet film, as shown above, you can observe the effect of heat on the gelatin coating

Mysteries *of* Photography



HOW TO MAKE A
Camera for Photomicrographs

New Appliances *for*

NOVEL HEAT INDICATOR. The heat control on this electric iron is marked with the names of materials to be ironed at various temperatures

STEAK PLATTER STAYS HOT This metal platter for serving meats is made of a special alloy that stays hot for a half hour after leaving the stove It is put on a chrome platter

ELECTRIC RANGE HAS A COAL HEATER A kitchen heater that burns coal, coke or wood is built into the electric range at the left It is so served to burn garbage

MIRROR ON TIE RACK A chrome mirror mounted on this tie rack adds to its usefulness as well as to its attractive appearance The rack is made of metal finished in lacquer and holds nine or more ties

FOR COCKTAIL FOODS

Cocktail sausages and other delicacies, impaled on gayly colored toothpicks, can be served attractively on this sphere of shining chromium

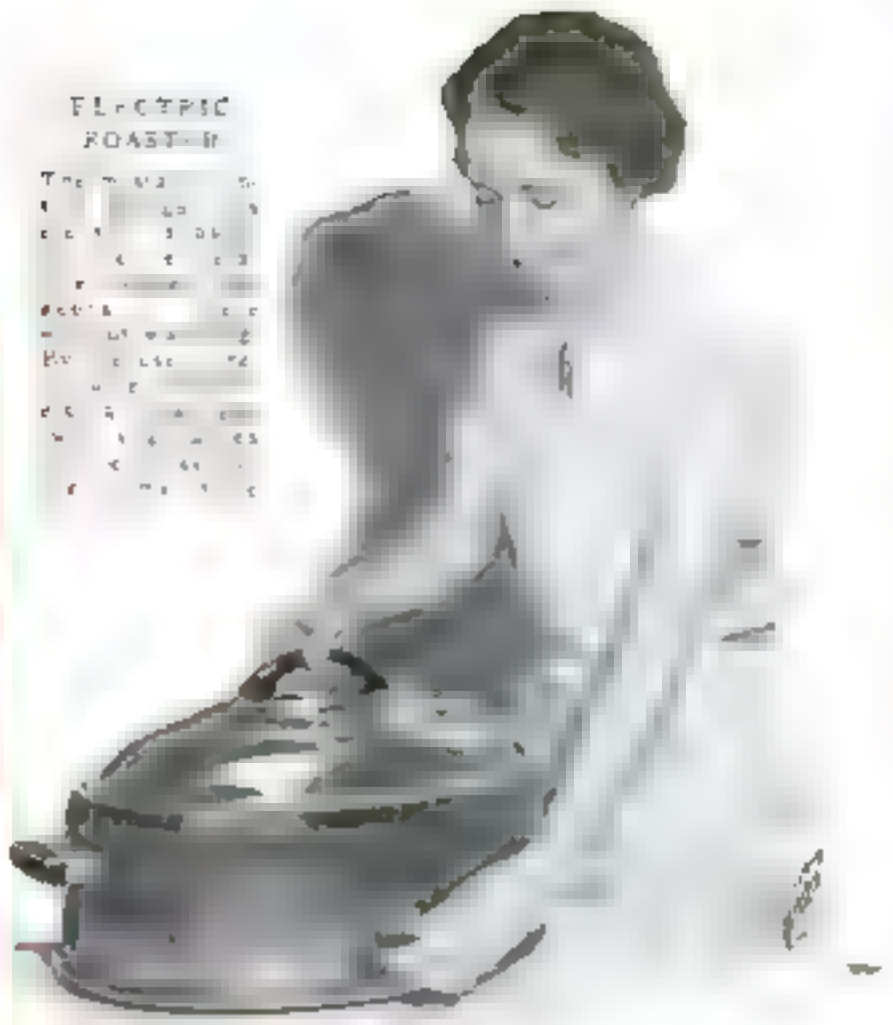
COMPACT DEODORIZER

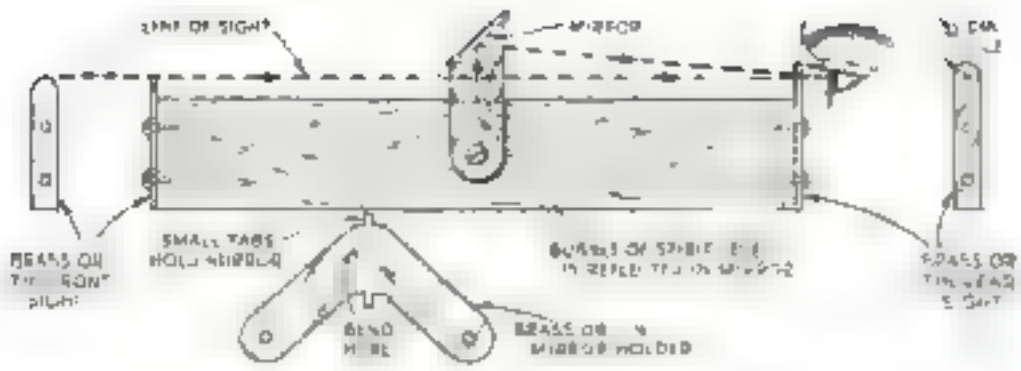
This small unit contains a powerful fan which drives air through a chemical preparation to overcome odors produced by cooking or smoking

POCKET HOLDS SOAP IN DISH MOP

Made of sponge rubber, the dish mop shown above and at the left is flexible and conforms to the shape of any dish Flakes, chips, or thin slices of soap can be placed in the pocket

the Household



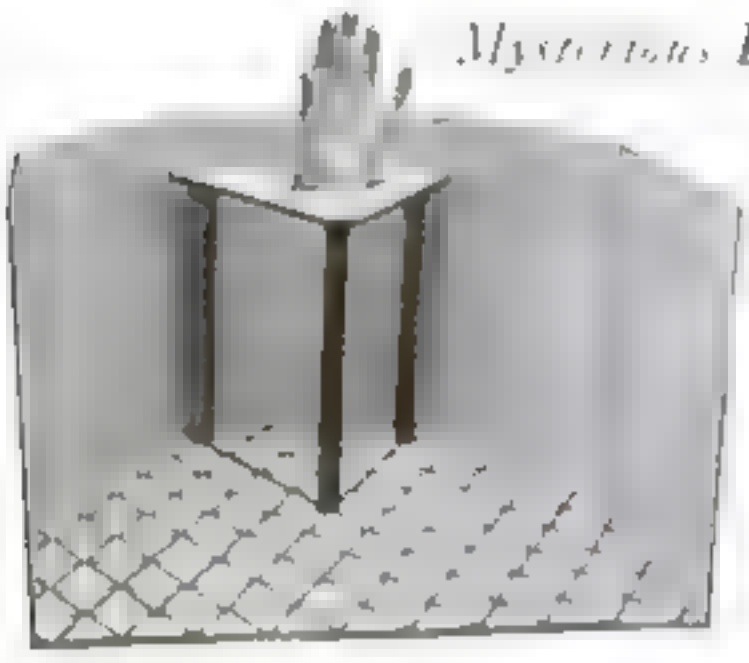


Simple Leveling Device

MOUNT a small mirror and two metal sights on an ordinary bubble level as shown in the photograph and sketch. In sighting, move the level until the bubble, seen in the mirror, is in the center of its "level" position. Then look past the end sight to determine the point where the horizontal line of sight strikes.

Tricks You Can Do with Mirrors

Mysterious Living Hand



A HUMAN hand apparently detached from the body moves mysteriously atop a three-legged table in this startling illusion. Mirrors set between the legs of the table reflect the backs of the screen and floor to give the effect of empty space. The hand is passed through a hole in the back screen, and up through a hole in the table.

Magic Bank Makes Deposits Disappear

YOU can mystify your friends with this trick bank. Let them inspect it and see that there are no secret compartments—only what appears to be a transparent partition of plate glass dividing it in the middle. This is really a pair of thin mirrors placed back to back and bound at the top with passe partout binding tape. Each mirror reflects half of the box and, no matter how you look at it, the partition seems to be transparent. Note how the pencil, in the photograph, disappears behind the glass. The cover is placed over one compartment and a coin is dropped through the slot. To the observer, the coin appears to vanish completely.

Mirror Used as a Square

To draw a line at right angles with the edge of a board, hold a mirror as shown. When the reflection coincides with the board itself, the mirror is square with it.

Ninety-Degree Mirror

THE reflection in an ordinary plane mirror is reversed (the right and left sides interchanged) as shown in the photograph at the left, in which the familiar clock face has a strange appearance. The ninety-degree mirror illustrated in the picture above, made with two mirrors meeting at a right angle, shows things as they really are, like a photograph. This is because the double reflection makes a double reversal, the second mirror correcting the effect of the first. In a ninety-degree mirror you actually see yourself as others see you. Another interesting property of this mirror is that you can see yourself in it from any direction within an angle of ninety degrees. A beam of light striking at perpendicular to the line where the mirrors join, is always reflected back upon itself. The mirror is not recommended for shaving, as all motions reflected in it are opposite to what they would be in an ordinary mirror. To demonstrate this, go through the motions of combing your hair in front of it. The effect is bewildering.

Un-Natural History

By GUS MAGER

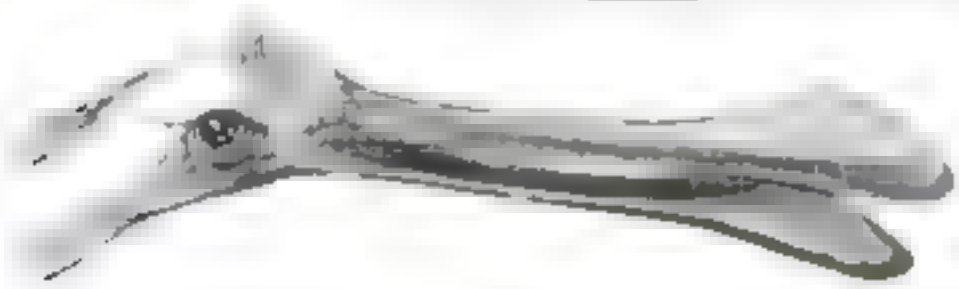
OBSERVE THE **FALCON'S** TERRIBLE HOOK FOR KILLING AND TEARING.

THE **PELICAN** TOTES AN ENORMOUS SACK, TO CARRY HOME THE FISH IN!

THE **SKIMMER'S** STRANGE BILL, WITH ITS UNDER MANDIBLE COMPRESSED LIKE A KNIFE BLADE THAT FITS INTO THE UPPER, WHICH IS HINGED AT THE FOREHEAD—A VERITABLE SCISSORS!

HERE'S A **SPOONBILL'S** BILL, FOR SIFTING SMALL CRUSTACEANS AND WHAT-HAVE-YOU OUT OF THE MUD!

THE FREAK BILL OF THE **AVOCET** SWISHES CURIOUSLY SIDEWAYS IN THE SHORE POOLS, FOR MINUTE FOOD.



THE MALE **RHINOCEROS HORNBILL** DURING THE BREEDING SEASON IMPRISONS THE FEMALE IN A HOLE IN A TREE BY MEANS OF HIS ASTONISHING BEAK TO PLASTER UP THE ENTRANCE, ALL BUT A SLIT THROUGH WHICH HE FEEDS MAMMA AND THE KIDS FOOD UNTIL THE YOUNGSTERS ARE NEARLY FULL-GROWN.

THE **PUFFIN'S** STRANGE "DURANTE" IS USED AS A SCOOP AND FOR AIR-TRANSPORTING SMALL FRY!

OLD Mother Nature surely handed out an astounding variety of freak tools to her creatures, with which to make their way in the world. Gaze on these few samples of unnatural-looking schnozzles of birds, for instance Some of them are actual monstrosities. However, they serve their purpose, though the bizarre helmet of the rhinoceros hornbill (left) certainly appears as useless as a glass eye at a keyhole—and ornithologists admit that its use is obscure. Note the resemblance to recent styles in women's hats.

Easy Home Experiments

SHOW

MOLECULES in Action

A FASCINATING world of tiny things awaits investigation in your home laboratory. You will need no microscope to explore it, in fact, the subjects of your search will be beyond the power of microscopes to reveal. They are molecules—the smallest possible particles of a substance that retain its characteristic properties.

Look at a drop of water. To your eye, it appears of uniform consistency It seems inert. Yet scientists say that if your eyes could magnify it enough, you would find it to be an aggregation of countless individual water molecules, scooting about helter-skelter in empty space like a swarm of disturbed bees. All substances—gases, liquids, solids—are so constituted, and the incessant gyration of their molecules explains many everyday phenomena that otherwise would prove mystifying.

How can you study such small things as molecules? Though you cannot see them, you can visualize their behavior by the effects that they produce. Remembering that they are constantly in motion will help you to understand what happens in the experiments that follow

Because of the wanderlust of their molecules, different liquids placed in contact with each other will mingle of their own accord. To demonstrate this, secure two wide glass tubes or cylinders. A pair of ordinary olive bottles, with the bottoms cut off will do nicely. Mount the bottles side by side in a vertical position, and connect them at the bottom with glass L tubes inserted through holes in corks and joined by a short length of rubber tubing. A screw clamp on the tubing will open or close the connection as desired. With the clamp closed, fill one of the cylinders with a strong solution of a colored chemical, such as copper sulphate or potassium dichromate. Half fill the other cylinder with water alone.

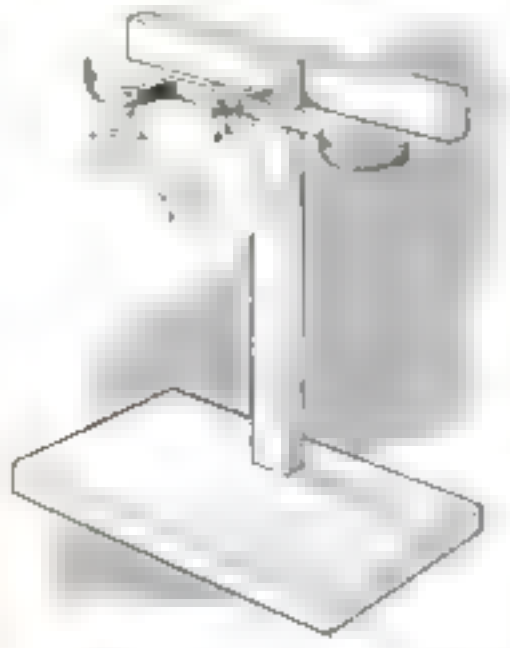
Open the screw clamp cautiously, allowing the heavy colored liquid to flow into the opposite cylinder beneath the water that it displaces. The two layers are distinctly separated. You might imagine that the heavy solution would stay at the bottom, and the plain water, which is lighter, on top. Instead, you will observe, after leaving the apparatus untouched for several days, that the two liquids are mixing Ultimately, all the fluid will be of uniform color. Molecules have strayed from one liquid into the other, until the two are completely intermingled.

To demonstrate the phenomenon of wandering molecules in a simpler way drop several crystals of a colored chemical into a tall, slim bottle or cylinder of water and place it where it will not be disturbed The crystals on the bottom dissolve, and their restless molecules travel upward through the clear liquid, eventually distributing themselves evenly throughout it and coloring it uniformly from the base to the top of the vessel.

A dishful of ordinary water contains an almost infinite number of speeding, jostling molecules. Some collide with each other and rebound. Others strike the walls of the vessel and bounce back. Some break through the surface of the water, only to be drawn back by the attraction of their fellows. Others, skyrocketing out with more force, are borne away by air currents and never return. It is the loss of these molecules that causes the water to diminish in volume. The water is said to evaporate. If the water is heated, the molecules move faster, and more molecules leave the water for good in a given time. Thus the volume of water decreases more quickly, especially if the water is heated to the boiling point. In any case the water will all leave the vessel eventually, but it will require a far longer time if it evaporates at room temperature than if it boils.

Just what is the difference between evaporation and boiling? In ordinary evaporation, water molecules escape into the air only from the surface of the liquid. When water boils, they escape both at the surface and also into bubbles within the liquid itself. It is the greatly increased surface provided by these bubbles that accounts for the rapidity with which boiling water turns to vapor

To complete the picture of a dishful of water, it is necessary to realize that molecules flying off from a liquid create, in the aggregate, an outward pressure that is

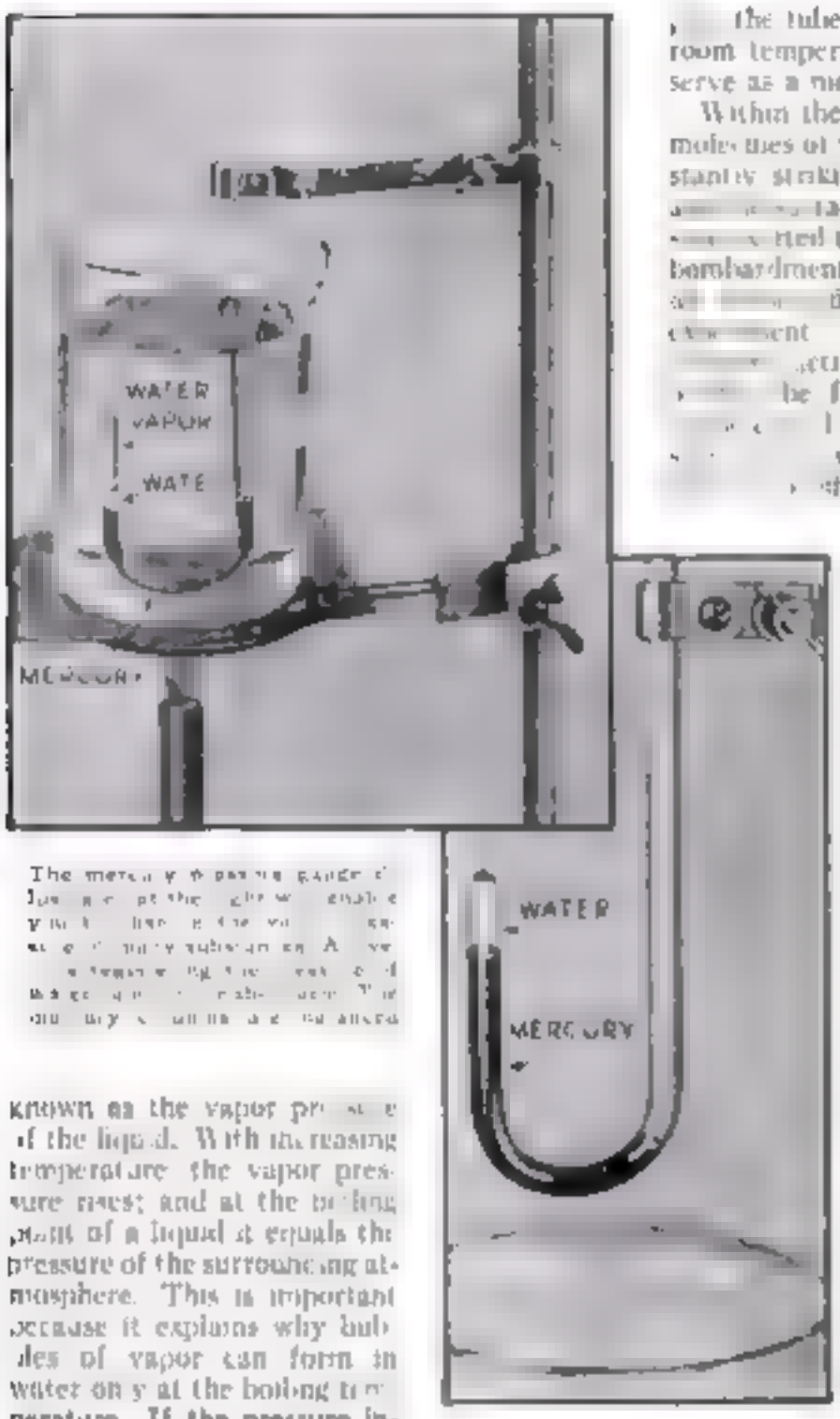


MOLECULES DIFFUSE LIQUIDS

Different liquids placed in contact with each other as in this set-up, will mingle of their own accord because of the activity of their molecules. The vertical rack illustrated is handy in many ways

Tiny Particles of Matter, Too Small to Be Seen Even Under the Microscope, Can Be Studied by The Experimenter Through Effects They Produce

By RAYMOND B. WAILES



The mercury vapor pressure gauge [illegible]

known as the vapor pressure of the liquid. With increasing temperature the vapor pressure rises; and at the boiling point of a liquid it equals the pressure of the surrounding atmosphere. This is important because it explains why bubbles of vapor can form in water only at the boiling temperature. If the pressure inside the bubbles did not equal that of the atmosphere, the bubbles would collapse.

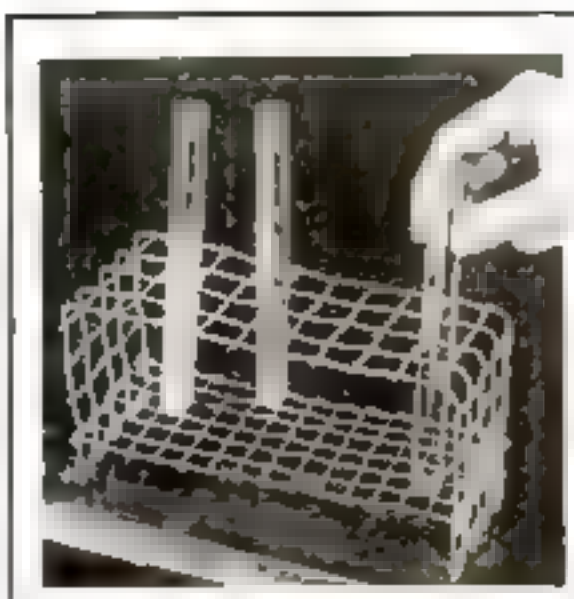
You can observe the vapor pressure of water and other substances with a simple piece of homemade apparatus. All you will need is a length of glass tubing about ten inches long and half a teaspoonful or so of mercury. Bend the tube into the shape of the letter J and allow it to cool. Then close the end of the short limb by heating it red-hot, flattening the end with a pair of forceps, and drawing out this pinched portion to form a point. Reheat the closed, pointed end until it is soft and workable, and you will find it easy to give it a neat rounded shape of uniform thickness.

Place enough clean mercury in the finished tube to fill the closed limb completely and to stand at a considerably lower level in the other limb. Now add a drop or two of water and manipulate the tube so that the drops rise through the mercury into the closed extremity of the "J. Support the tube in a beaker of water at room temperature and it is ready to serve as a mercury pressure gauge.

Within the closed end of the tube molecules of water are in motion, constantly striking the end of the tube [illegible] face of the mercury. Pressure exerted upon the mercury by the bombardment of water molecules has at present effect at the start of the experiment however. External air pressure acting through the open end of the tube forces the mercury up in the closed end, and the vapor pressure of water at room temperature is sufficient to overcome this pressure.

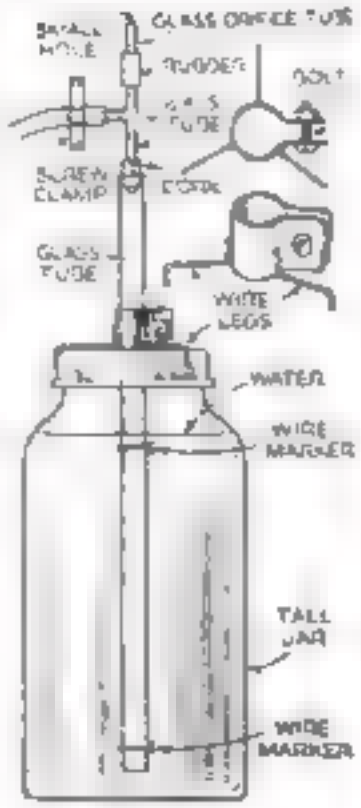
Now start heating the water in the beaker. For awhile nothing appears to happen. Nevertheless, the heat, transmitted through the glass walls of the tube to the drops of water inside is speeding up the motions of their molecules and raising the vapor pressure. Finally a second or two after the water in the beaker is boiling, you will see a bubble of vapor form in the tube and push the mercury suddenly downward. At this point the water in the tube is still not quite at the boiling temperature, because of the lag in heat transmission. The rising vapor pressure of the water, however, has already become sufficient to overcome the opposing pressure (which is equal to that of the atmosphere, less a slight amount due to the original difference in level of the mercury columns). As soon as the water in the tube has had time to reach the temperature of the water boiling in the beaker—212 degrees F.—the mercury stops falling. It now stands at the same level in each tube, showing that the vapor pressure of water at the boiling temperature exactly equals the atmospheric pressure.

If you remove the tube from the beaker of boiling water, its contents cool and the action is reversed. The molecules of water slow down, the vapor pressure drops, and the mercury jumps upward in the closed end of the tube as the bubble of water vapor collapses. Another way to reverse the action, without cooling, is to raise the external pressure upon the contents of the tube, which you can do by attaching rubber tubing to the open end of the gauge, closing the free end of the tubing, and squeezing the rubber with your fingers. The water would then have to reach a higher temperature than before in order for *(Continued on page 119)*



A CONVENIENT TEST TUBE RACK

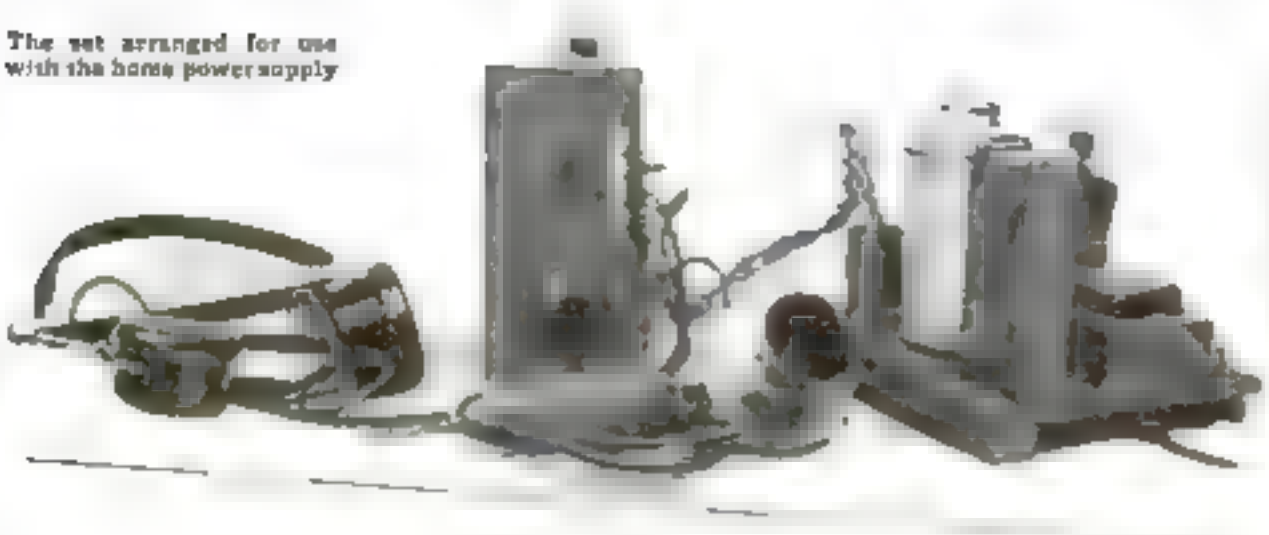
This handy rack can be made in a few minutes from galvanized screening. The upper section is of three quarter inch mesh and the lower of half inch mesh. The two sections are joined by soldering or wiring.



Schilling's apparatus illustrated in the drawing at the left is being used above for making an observation on the specific gravity of illuminating gas. It times the escape of a measured quantity of air

Portable Radiophone

The set arranged for use with the home power supply



THREE dollars worth of parts, a few batteries, a pair of earphones, and a microphone are all you need to build the novel five-meter transceiver illustrated. Yet it is a complete radiotelephone that can be operated in a moving vehicle as well as in the home station.

Probably the first radio distress call ever sent from a moving bicycle was transmitted with this compact set. During tests the author, operating the transceiver as he pedaled along a country road, noticed that the front tire on his bicycle had developed a leak. A hurried call on the radiotelephone to a brother experimenter back in town brought the necessary repair materials long before the tire was entirely flat.

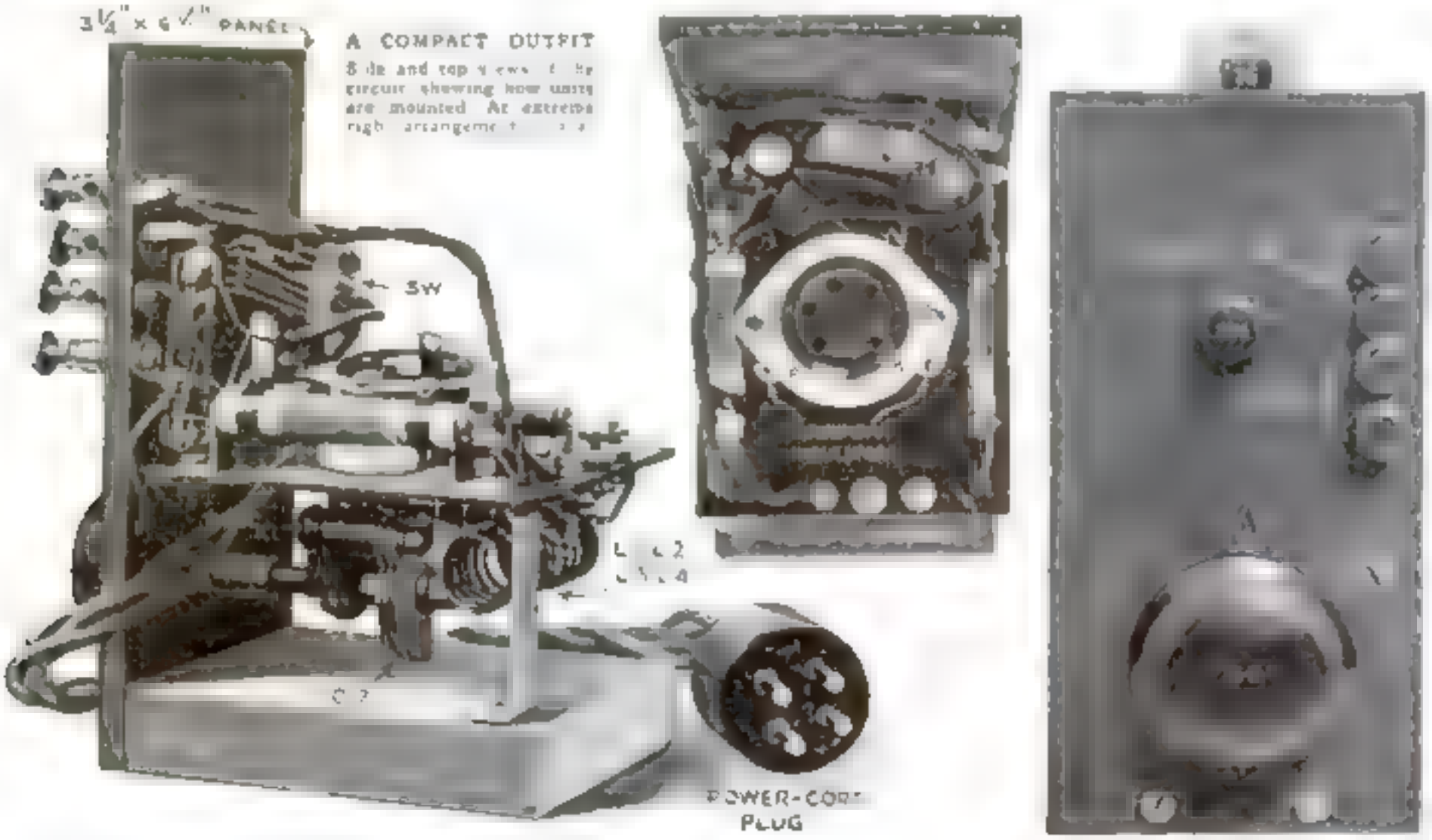
Of course, as with all five-meter transceivers, the range of the circuit is limited ordinarily to a few miles. Operated in a moving automobile, with only 135 volts of "B" batteries and a short push-pole antenna it put a good signal into a one-tube superregenerative receiver located two miles across town. When used at a fixed station, with a higher plate voltage and a good antenna, it gave a considerably greater range.

However, what five-meter equipment lacks in power and range, it more than makes up for in simplicity, low cost and noise-free operation. In the transceiver shown, for instance, a single type of '76 tube is used for both transmission and reception. With the panel switch (SW) in one position, the set is a sensitive superregenerative receiver; with the switch in the other position, the same circuit acts as a low-power radiophone transmitter.

The circuit used is a very simple one, based on the split-coil Hartley hook-up. For reception, a large grid-leak resistor causes the tube to superregenerate. Throwing the switch for transmission reduces the grid-leak resistance and the tube acts as an ordinary oscillator. It also shorts out the headphones and opens the absorption-modulation circuit consisting of two turns of wire connected to a single-button microphone. Despite the simplicity of this form of modulation, it is capable of modulating the transceiver with surprisingly good quality and has proved much more effective than the grid modulation used in other simple transceiver circuits. During reception, the modulation coil is, of course, shorted out by the switch to prevent the absorption of the radio frequencies.

In building the set, the five-prong socket for the type '76 tube is mounted above the 3½ by 3½-inch composition subpanel on two stand-off insulators. The two grid leaks, the five-meter radio-frequency choke, and the .004-mfd. by-pass condenser (C_4) are also mounted above the subpanel.

The variable condenser (C_3), the coils, and the fixed condenser (C_1) connected between the coils, are mounted on the underside of the subpanel. Each half of the split coil (L_1 and L_2) consists of five turns of No. 14 wire wound to have a one-half-inch inside diameter. The coils are spaced out to be one half inch long and are placed to provide a half-inch space between them. The coils should be mounted directly on the .0001-mfd. fixed



costs only Three Dollars

THIS SIMPLE FIVE-METER TRANSCEIVER CAN BE USED AT HOME OR IN YOUR CAR

By Stanley Johnson

•

The author using the five meter radiophone from his bicycle. The set batteries, and fish pole antenna are mounted in the package carrier

condenser and the leads to the variable condenser should be as short as possible. Although the lengths of the other leads in the set are not critical, they should be reasonably short.

The antenna coil (L_3) and the modulation coil (L_4) each consist of two turns of No. 16 enameled wire close wound to have a ⅜-inch inside diameter. They are fastened to the subpanel with machine screws and are mounted so that they are between the two coils (L_2 and L_5) of the oscillator. The machine screws that hold the antenna coil should extend through the subpanel to serve as connections for the antenna.

The 3¼ by 6½-inch pressed-wood composition panel is fastened with wood screws to the 3¼ by 4-inch wood baseboard. On the panel are mounted the four binding posts for the microphone and headphones, the dropping resistor, and the switch. The dropping resistor, used to reduce the plate voltage during reception, may be omitted if the plate supply is less than two hundred volts. There is an insulating shaft between the control knob on the panel and the variable condenser. Twisted hook-up wire connects the microphone binding posts with the modulation coil.

Although the jack switch used in the transceiver was originally a triple-pole, single-throw unit constructed to close three circuits, it was modified so as to close two circuits and open one. In changing the switch for use in the transceiver, the top metal leaf was bent up so that it no longer made contact when the switch was turned. Then a piece of copper wire was soldered to the top leaf and bent down under the second leaf to make contact with the leaf only when the switch is in the "off" position. This portion of the switch shorts out the modulation coil during reception. A brief examination of the average switch will show how easily this change can be made. For simplicity, the three portions of the switch are indicated separately in the drawing.

A four-wire cable, made from twisted lamp cord, serves as the power cord for the transceiver. At W9LBV, the author's station, the cord is soldered to a four-prong tube base, which plugs into a short-wave receiver power supply. Up to three hundred volts have been used on the transceiver. For portable operation, a storage battery in a car, four dry cells, or a string of flash-light batteries, can be used to light the 6.3-volt filament, while portable-size B batteries can provide the plate supply. For maximum portability, the flexible, ribbon-type "B" battery recently described (P.S.M., Feb. '35, p. 58) can be used for the plate supply. This type of battery can be folded into any shape or worn around the body in the manner of a cartridge belt.

The set should be tested first with the switch (sw.) in the "receive" position. If the circuit is wired properly the characteristic superregenerative hiss will be audible in the phones. With the switch in the "send" position, a dial lamp soldered to a small turn of wire and held near the coils should light and talking into the microphone should vary the intensity of the bulb. The coupling (relative positions) of the coils should be adjusted for the best modulation and maximum output.

Of the several varieties of antennas that can be used with the transceiver, the Marconi type is the simplest. One end of the antenna coil is connected to the cathode of the tube and the other end to a rigid copper wire or aluminum rod, forty one inches long as shown in the illustrations. With this type of antenna, no antenna tuning is necessary.

Since this outfit consists of a transmitter as well as a receiver, an amateur license is, of course, required to operate it. These licenses, as described in previous issues, are granted by the Federal Radio Commission after the applicant has passed an examination and code test.

What You Need To Build This Transceiver

C_1—Fixed condenser, .0001 mfd.

C_2—Variable condenser, .00015 mfd.

C_3—Fixed condenser, .001 mfd.

R_1—Fixed resistor, 10,000 ohms, 1 watt.

R_2—Fixed resistor, 100,000 ohms, ½ watt.

R_3—Fixed resistor, 30,000 ohms, 1 watt.

M—Microphone, single-button.

RFC—Radio-frequency choke, five-meter.

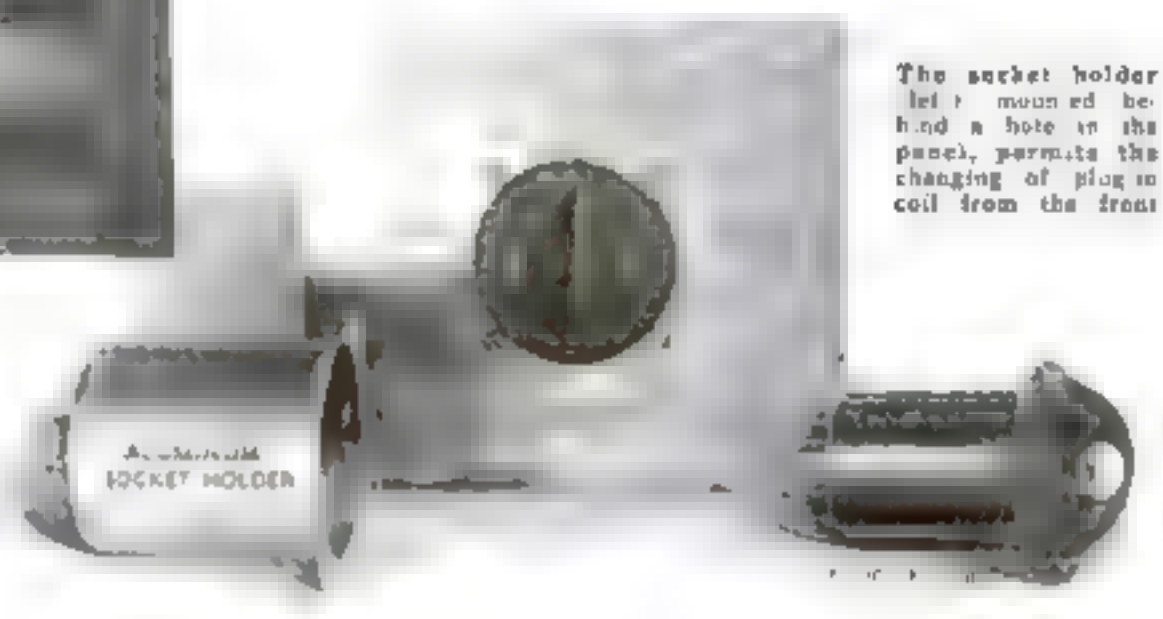
SW—Switch, three-pole single-throw altered.

Miscellaneous: Wire for coils (one turn), wire for antenna, binding posts, knobs, earphones, batteries, solder, type '76 tube, etc.

Handy Aids for Radio Workers

Combination Slide Rule And Stroboscope

A COMBINATION stroboscope and slide rule is a new aid for the radio experimenter. Placed on the turntable of an electric phonograph and viewed with a sixty-cycle neon lamp, as shown, it can be used to check the turntable speed. Two rows of dots, when viewed under the flashing neon light, provide the stroboscopic effect; one row appearing to stand still at exactly 78.26 revolutions a minute, the speed for ordinary records; the other appearing to be stationary at 33 1/3 revolutions per minute, the speed for special slow-speed records. A dial and indicator arm provide the slide-rule features.



The socket holder (left) mounted behind a hole in the panel, permits the changing of plug-in coil from the front

Panel Mounting Makes Coil Changing Easy

ANY homemade receiver can now be fitted with the panel type of plug-in coil mounting used on more expensive commercial short-wave sets. A combination socket holder and shielding can shown at the left in the photograph above, is mounted behind a hole cut in the panel. The plug-in coils, provided with handles, slip into this holder, fitting flush with the panel face. By placing the coils within easy reach this arrangement eliminates much of the bother of coil changing. Because of the aluminum coil holder, the windings are shielded to eliminate body-capacity effects.

New Glass Tube Inclosed In Metal Cylinder

ANOTHER new type of tube recently has been placed on the market—the metal-glass tube. Although outwardly resembling the new all-metal tube, it is in reality a glass unit inclosed in a metal cylinder. As with the all-metal tube, the case (shown partially removed in the accompanying photo) serves as a shield. Available in all the various glass-tube types, these combination tubes are provided with the universal "octal" bases.

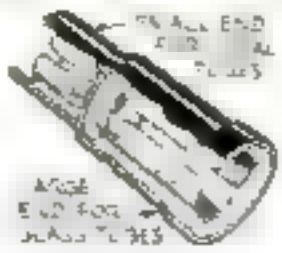
Rochelle-Salt Crystals Used In Nonmagnetic Headphones

IN HEADPHONES of a new design a piezo-electric unit consisting of Rochelle-salt crystals replaces the usual electromagnet. Vibrating in response to the electrical impulses from the output of the receiver the crystals actuate a small cone in much the same way that they vibrate the cone of the piezo-electric loudspeakers already described (P. S. M., Oct. '34, p. 571). Being nonmagnetic they can be used in airplanes and locations where the presence of an electromagnetic field might upset the readings of compasses and delicate instruments.

Six New Accessories for Metal-Tube Sets

THREE types of "octal," eight-hole sockets, two varieties of tube bases, and a new combination grid-cap connector are now available for metal-tube receivers. Being double-ended, the combination grid-cap connector serves a dual purpose. One end, the larger, fits the regular glass tubes while the other is designed for all-metal tubes, allowing substitution of either type tube in a receiver without replacing the grid-cap connectors. The unmounted eight-prong tube bases are particularly valuable in making tube adapters and coil forms.

Accessories for metal-tube receivers. Drawing shows grid-cap connector



Tube Socket Mounts on Panel Face

WITH the socket holder shown, tubes to be added to a completed circuit can be mounted on the face of the panel. Finished in black crackle enamel, the bracket takes a socket of either the glass-tube or metal-tube type. A hole at the rear provides entrance for connecting wires. Though designed for front-panel mounting, it can be fastened to any vertical surface.

Question: How hot is lava as it emerges from the crater of a volcano?—H. T. Joliet, Ill.

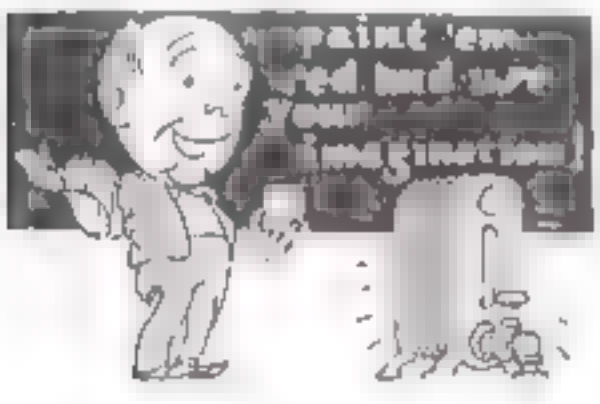
Here's *the* Answer

A.—THE temperature of liquid lava is very high. The uppermost layers in Kilauea Crater on Mauna Loa in Hawaii register about 1,000 degrees C

Good Thing Air Is Free

Q.—HOW much air do we breathe during the course of a day?—H. A. B., Savannah, Ga.

A.—A NORMAL adult, it is estimated, inhales and exhales from 400,000 to 650,000 cubic inches of air during twenty-four hours.



For More Radiator Heat

Q.—DOES the painting of radiators with gold or aluminum paint cause a loss of heat?—O. M. J., St. Louis, Mo

A.—ABOUT twenty percent of the heat of radiators is lost, according to the Bureau of Standards, when they are painted with gold or aluminum paint. A light-colored house paint is recommended

Those Blue-Eyed Babies

Q.—WHY is it that babies' and animals' eyes which are blue at birth frequently change to another color?—O. T. E., Cambridge, Mass.

A.—NEWBORN babies or animals, with the exception of those which have very black eyes, have no pigment in the front of the iris. The apparent blue color of their eyes is probably due to the suspension of exceedingly fine particles in the front of the iris. These particles absorb certain rays of light which, in combination, we recognize as blue. The pigment of the iris, while present at birth, does not become fully distributed until sometime later

From Left to Right

Q.—WHY are the majority of people right-handed?—L. G., New York City

A.—MOST of us are right-handed because the nerve centers controlling the right arm are normally located in the left side of the brain, which is the more highly developed. The nerve fibers from each half of the brain cross at the base of the brain to serve the opposite side of the body. In addition to controlling the muscular movements of the right side of the body, the left lobe of the brain also normally contains the nerve cells we use in reading and speaking. In the case of left-handed persons, this condition is reversed

A Pioneer Beacon for Ships

A. L. K., PAWTUCKET, R. I. The first lighthouse on American soil is believed to have been erected at Beaver Tail, R. I., in 1749

When Colors Are All Wet

Q.—WHY is it that colors in cloth seem deeper and brighter when wet?—A. F. C., Erie, Pa.

A.—COLORS in wet cloth appear deeper in shade because particles of water between the threads of the fabric cause refraction of the light rays.

Just an Old British Custom

Q.—PLEASE explain in one of your next issues why a billion in the United Kingdom is a different number than that designated by a billion in the U. S. A. or France?—J. C., S.S. *Manila Prizmonic*

A.—THE difference in designating the large numerals in the two systems is an arbitrary one. In the English system, the billion is a million millions, a trillion a million billions, and each higher denomination is a million times the preceding one. In France, other continental countries, and the United States, however, the billion is a thousand millions, and each higher denomination is a thousand times the preceding one. The milliard, chosen in England to designate a thousand millions, is equivalent to our billion.

It's a Long Way Home

Q.—DO FRESH-WATER eels migrate into the ocean during the breeding season?—I. T. C., Hagerstown, Md.

A.—AMERICAN and European fresh-water eels migrate to the Sargasso Sea to mate and to die. Among the weed masses of this drifting sea, the young are hatched and grow until they reach the elver stage, at which time they travel back to the streams or rivers of the continent from which the parent eels came. These migrations entail in many cases journeys of thousands of miles

The Rigor of Death

Q.—DOES rigor mortis ever set in immediately after death? Also, what is the usual interval after death before this condition exists?—T. C., Tulsa, Okla.

A.—RIGOR MORTIS, stiffening of the muscles after death, may occur instantly in cases where death was preceded by great nervous tension or excitement, as with soldiers killed in battle, suicides, and drowned persons. Normally, rigor mortis is present over the whole body in twelve to eighteen hours after death. This reaction disappears in about the same period of time.

Permanent Whitewash

Q.—IS THERE any way in which whitewash can be prevented from rubbing off?—A. C. R., Rockford, Ill.

A.—ALUM added to the whitewash before applying will prevent its rubbing off. A trial patch covered with the whitewash will enable you to tell if you have added enough alum for the type of surface to be covered.

A Slow Transformation

C. A. A., OAKLAND, CALIF. The average life of radium is estimated to be 2,500 years. In other words, it takes twenty-five years for one percent of a mass of radium to become transformed to elements of lesser atomic weights

Giant Walking Sticks

Q.—WHAT species is considered the giant among insects?—B. A. B., San Antonio, Texas

A.—PROBABLY the largest insects are found among a species of "walking sticks" which are native to the East Indies. The largest of these measure a foot in length and their bodies have a maximum breadth of two inches. They have a wing spread of about eight inches.

To Clean Gilded Frames

Q.—WHAT is the best method for cleaning gilded picture frames?—L. M. C., Newark, N. J.

A.—FOR cleaning gilded woodwork, such as picture frames and moldings, a satisfactory medium is liquor potassae (potash solution) diluted with five volumes of water. Denatured alcohol (methylated spirit) is also suitable for this purpose. A soft brush or cloth can be used for applying either of these preparations.

Mountains of Interference

Q.—DO YOU think the large deposits of iron ore in this vicinity have anything to do with our poor daytime radio reception?—A. W. W., Negaunee, Mich.

A.—BECAUSE of their shielding effect, mountains containing (Continued on page 134)

"Why aren't modern cars fitted with built-in heating systems?" the real estate man asked. "Ask me something easy," Gus growled in reply

By MARTIN BUNN

Don't Drive a Rolling Ice Box

"ARE you afraid those sandwiches will run away if you don't eat 'em quick enough?" Gus Wilson, veteran auto mechanic of the Model Garage asked his partner, Joe Clark, as the latter emptied his lunch kit at record-breaking speed

Have you forgotten that real-estate man is due here at twelve-thirty?" countered Joe, between mouthfuls. "Remember you promised to give that house he's trying to sell me the once-over. The missus says she won't even look at it till you say it's built sound enough to be a good buy."

"It had slipped my mind," Gus confessed. "Here he is now," he added, as a shiny new sedan of the latest type stopped in front of the window of the little office of the Model Garage

A few minutes later, the two garagemen were sitting in the sedan while Harkins, the real-estate man, piloted it into a new residential development just outside the town.

"There you are—the niftiest little place in this part of the state," Harkins exclaimed, as they pulled up in front of a neat-looking five-room bungalow. "Yes, sir, that's a real, up-to-date home. An honest job all the way through—no jerry-built junk. Why, that house is just as modern as this car is, in every way!"

"Humph!" Gus grunted. "I don't think you really mean that, mister, because if you do, you're telling us that the house you're trying to sell my partner, here, hasn't any heating plant!"

"Well—er—no heating plant!" stuttered Harkins. "I never thought of it that way but, by George, you're right! The house has a heating plant—and a mighty good one, as you'll see. Come to think of it, why aren't modern cars fitted with built-in heating systems, too?"

Ask me something easy," growled Gus. They got out of the car and strolled around the house to get a view of the outside appearance

Most bungalows have no cellars, this has one," said Harkins as he led them in through a cellar door

Gus examined the heating plant with care. "One-pipe steam," he observed. Boiler looks plenty big enough and there's an automatic thermostat control too. Speaking of automobiles again," Gus went on, "the first manufacturer to put out a car with a real, built-in heating system thermostatically controlled like this house-heating plant, will find, I'm thinking that he's got a feature that will be a lot more popular than some of the gadgets they've played around with so far!"

"I'd fall for it quick," Harkins agreed as they started up the cellar stairs. "Sure would be fine to be able to drive without even a hat or overcoat in zero weather."

The subject of car heating did not crop up again while they were inspecting the bungalow but it was evident that Harkins was mulling over the idea.

"I suppose," he observed, as he drove Gus and Joe back to the garage, "that it would cost more to run a car that was heated as warm as your house in very cold weather. It would take a lot of heat."

"It shouldn't add a penny to the cost," said Gus, buttoning his overcoat up under his throat. "You're throwing away, all the time you drive, enough heat to keep the air in the car at least seventy degrees—and with plenty of ventilation, too.

More than enough heat to keep a full-sized house radiator good and hot is going out your exhaust pipe all the time and the air that flows through the engine cooling system carries away enough heat to do the same job all by itself."

"Yes, I can see how that can be," Harkins agreed. "All the energy of the gasoline that you don't actually use in driving the car has to go somewhere and wasted heat is where it goes. I suppose I've often thought of having a heater put in the car but they give a lot of trouble don't they?"

Not if you get a good one and have it installed right," Gus answered as they pulled up in front of the Model Garage. "Stop in a few minutes and get warmed up, while I show you some good ones—and bad ones!"

Joe ducked into the office to phone his wife about the house while Gus led Harkins back to an old limousine in the rear of the garage

"Speaking of heater trouble," said Gus as he pulled open the door and pointed to a brass affair on the floor "here's the kind of a heater you are sure to have trouble with—and mighty serious trouble—if anything really goes wrong. In this outfit there's a special valve in the exhaust pipe of the car and when you move it to one position, a part of the hot exhaust gases flow through the piping in this brass gadget. If anything happens and the piping inside the car springs a leak, somebody is likely to get knocked out by carbon monoxide poisoning.

Then, there's always a possible chance for a fire with this kind of an outfit because, if the (Continued on page 116)

PLANS FOR CONSTRUCTING A MAGNIFICENT MODEL OF THE

GREAT REPUBLIC

Largest Clipper Ship Ever Built in the United States

By Capt. F. Armitage McCann

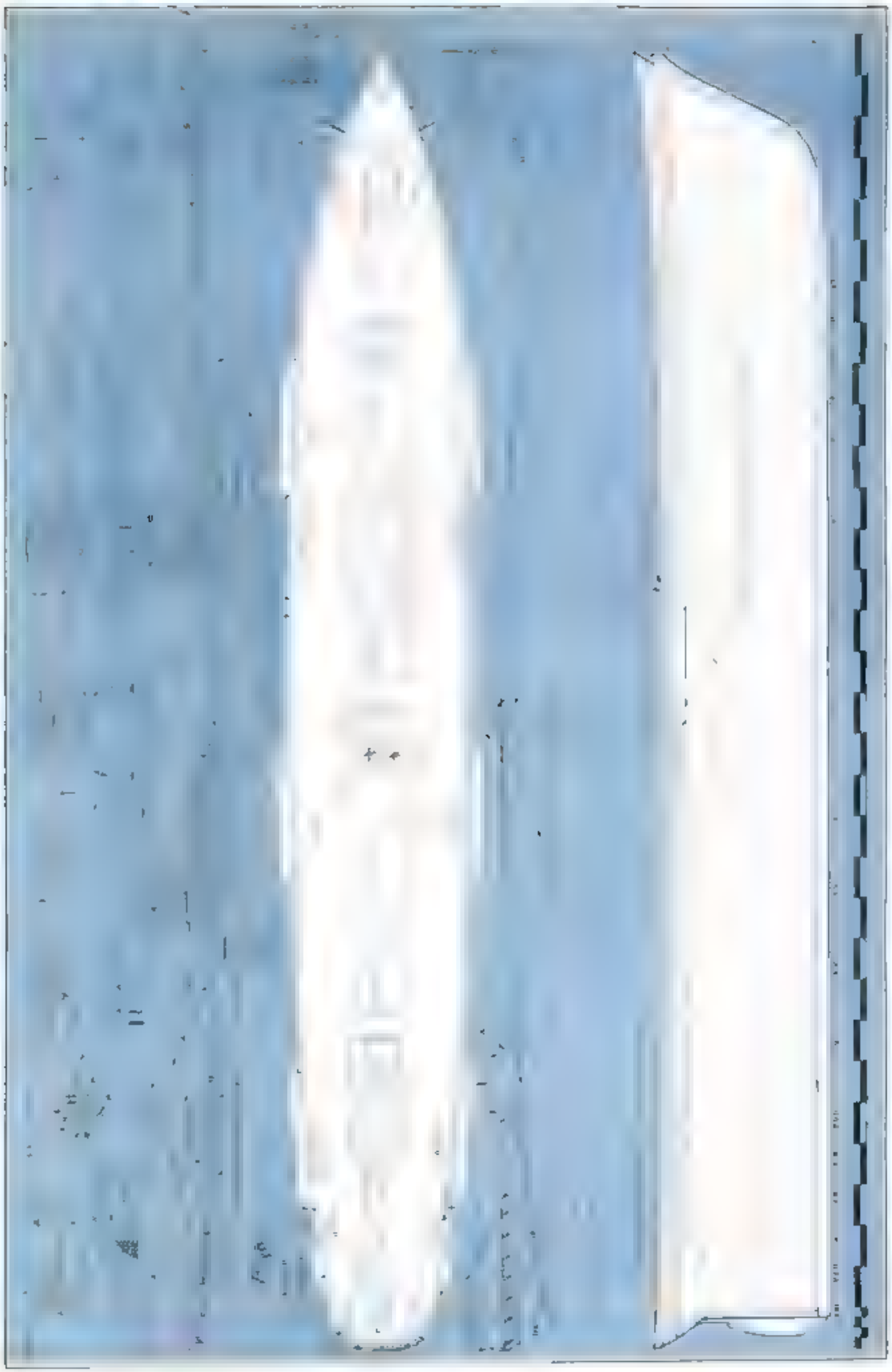
CLIPPER ships are deservedly favorites with model makers. The clippers embody all the romance and adventure of the days when American ships

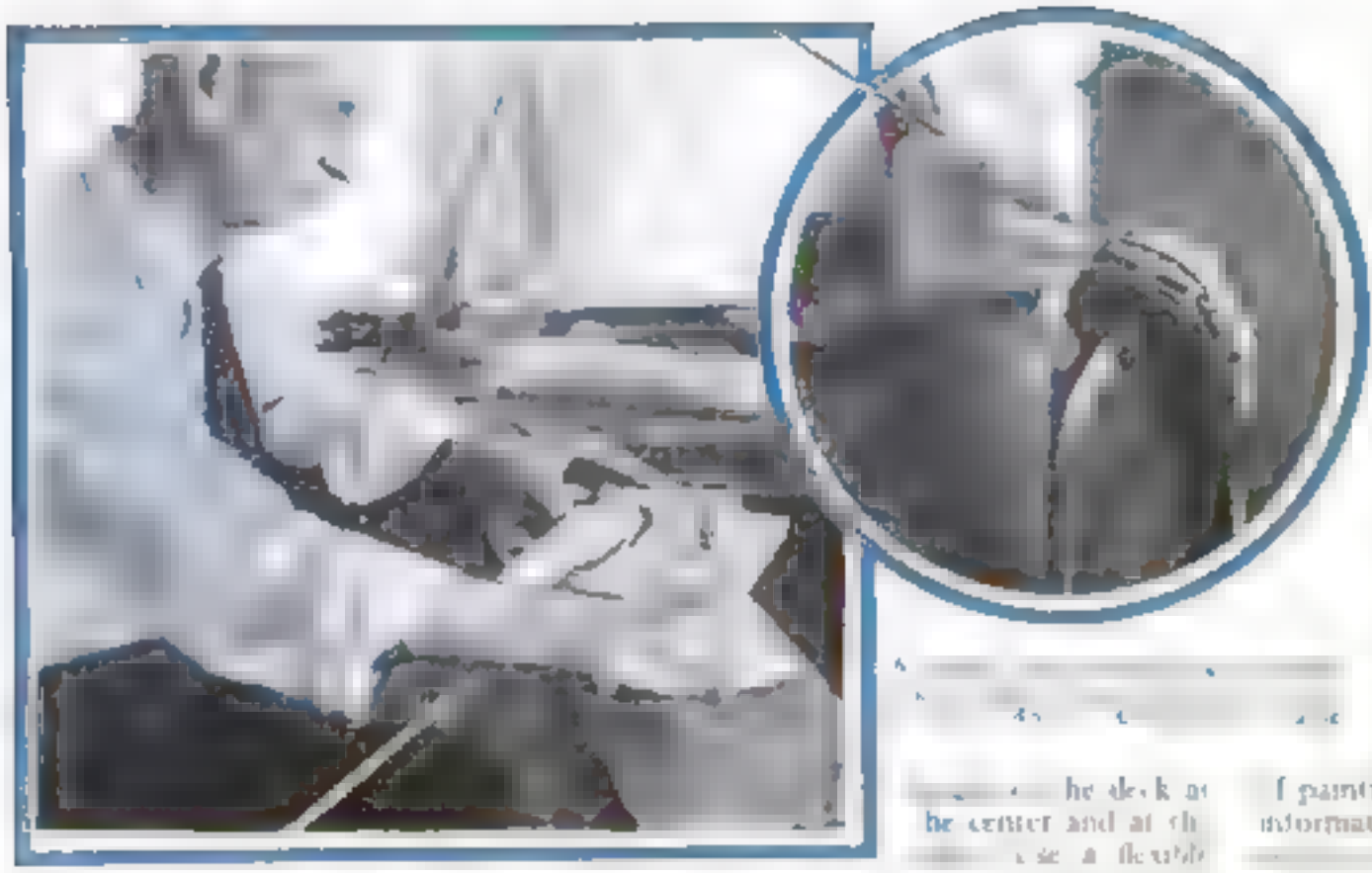
bled several miniature and- ls of this type, now we or a more elaborate and de- the *Great Republic*. To de- sign, actual experience in sail- ships and years of study of the type and period have been necessary. Months of work have been put into the model in the photographs in order that our may have instructions for making hat will be as correct as possible t in detail as can be managed pter!

public was built at East by Donald McKay to his design at his own risk. She was he largest merchant sailing ship ever con in the United States and was designed to carry 6,000 tons. nately, while loading in New York before starting on her first voyage, she burnt almost to he water line. When rebuilt she was cut down one deck and her sail plan was reduced.

There have been very few larger wooden sailing vessels ever built and she was the crowning achievement of America's most famous shipbuilder. For this reason we have preferred to make the model of her as originally conceived and built. In case any readers have pictures of the *Great Republic* that differ from this model it should be noted that all pictures of her we have seen show her as rebuilt with the exception of a woodcut of her launching and two when on fire.

The *Great Republic* had a register + 555 Her dimensions were





length 335, beam 53, depth 38 ft. As we are working to the scale of 3/32 in. equals 1 ft. of the original, this gives us a hull 31 13/32 by 4 31/32 by 3 9/16 in. She had a 20-in. dead rise. The keel was 16 by 32 in. and forward for 60 ft. gradually rose in an arc of a circle. There were four decks with 7 ft. between the upper and 8 ft. between the others. The upper deck was a flush or spar deck with no poop or forecastle. The figurehead was an eagle's head, and there was a spread-eagle holding the American shield on the stern.

To make the hull on the lift or layer plan, get five pieces of 1-in. white pine or sugar pine dressed to 15 16 by 3 by 3[illegible] in. and one piece for the lowest 1 ft. of [illegible]-in. pine dressed to 7 16 by 4⅝ by 28 ½ in. These are the usual thicknesses of wood as supplied by lumber yards, if not obtainable, the wood can be dressed to the correct thickness or the plan can be altered to suit the wood by redrawing the horizontal lines on the body plan and altering the half-breadth plan from these new positions. In either case you will need full-size layouts or blueprints.

With tracing paper and carbon tissue transfer the half-breadth lines *a* to *f*, the midship line, and some of the construction lines I to XXII to the boards and cut them to shape. Extend the midship and construction lines over the edges.

Pieces *B*, *C*, *D*, and *E* had best have the inside waste wood cut out with a jig saw to within about 5 16 in. of the size of the lift next below each. A bridge of wood should be left near the middle of each to prevent its spreading when clamped for gluing. Glue these together so that the construction lines coincide.

The half-breadth lines shown are not strictly water lines, but are the greatest width required for each piece in the finished model.

Trace the lines of the body plan onto pieces of stiff cardboard, marking also the positions of Line *d* and the center of the keel. Cut these out and recheck them for shape by laying them on the body plan. I find it a good plan to cut the templates straight up from their widest point, later cutting the tumble home on the model to the deck measurement.

From line *a*, mark at each station the [illegible] the deck at the center and at [illegible] use a flexible straightedge to draw smooth curves through the marks (better get some one to help hold the straightedge).

Fasten the hull down on the bench with a clamp at one edge, or by other means, and shave down to the deck line at the center. Make a template with a curve of ½ in. to the foot and shave the sides of the deck until it fits, thus leaving a crown or camber. In cutting any part, always allow something for sandpapering.

To hold the hull for the next process, a stout wooden bar can be screwed to the deck, the screw holes being where a hatch or house will later cover them. This bar should have octagonal ends, which may be held at any angle in two vises, one at each end of the bar.

Make templates of the end profiles and cut the ends to shape. Mark the width of the stem, sternpost, and keel on the ends and bottom. Shave the sides down until the templates fit at their respective stations when held at right angles to the hull, with the midship and *d* marks in position. Gradually bring the hull down to shape all along, so that there are no bumps or hollows. Recheck the deck level after the tumble home is cut.

These processes may be reversed, but I have found that on a large model it is handier to cut down to the deck first.

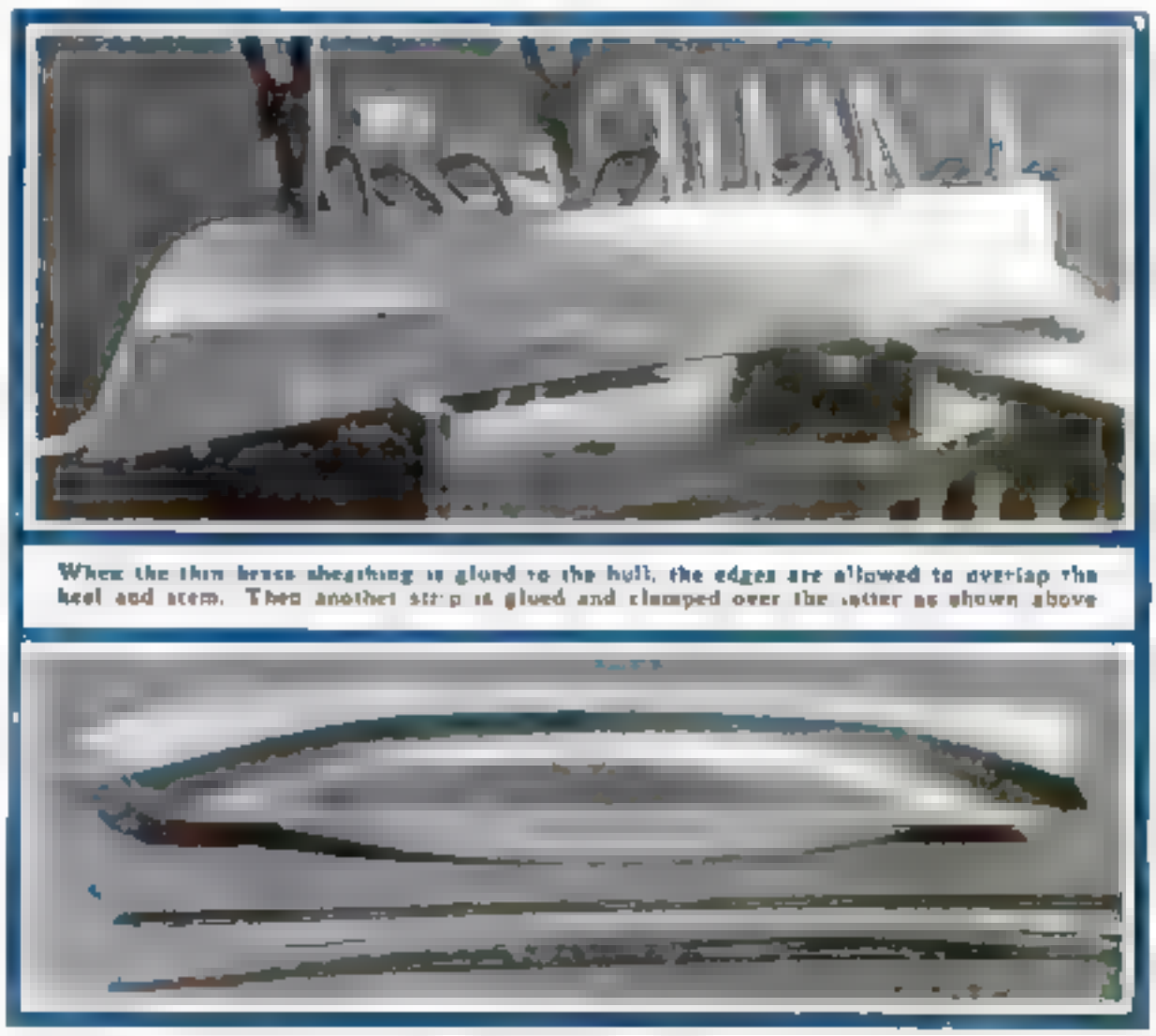
Hints for the novice on this work have frequently been given in the past and reprinted in book form, together with lists of suitable tools and suggestions in regard to materials, methods of painting, and similar topics. Since the information is readily available it will [illegible] repeated.

The stem goes on now, the shape and thickness shown. I cut mine at the top to include the figurehead, with the grain there lengthwise and a bit thicker than the rest, and carved the eagle's head right on it, but this can be carved separately and glued on. The stem comes almost to an edge in front. Cut a gammoning slot in it.

Glue and nail on the keel, to extend under the stem, where it is nailed. Where it rises at the bow from line VI it might be steamed, but I cut it to shape. Then the sternpost is fitted.

At this point a temporary cradle should be made, which may be just two embracing uprights, lined with felt and nailed to a board.

There are (Continued on page 95)



When the thin brass sheathing is glued to the hull, the edges are allowed to overlap the keel and stem. Then another strip is glued and clamped over the latter as shown above

The shaped hull with one side sheathed with brass. In the foreground are strips for finishing the other side. The plate divisions are indented with a small clock sprocket wheel

For information about our blueprints, turn to page 78.

TEN EASILY MADE

Games... Toys... Novelties for CHRISTMAS

By DONALD W. CLARK

YOUR home workshop can help Santa Claus out a lot when it comes to making games, toys, and small novelties. The accompanying drawings offer ten suggestions, and you can use a most any of them as a starting point for additional designs of your own.

In the high flyers game, each player spins the disk once in turn and scores the number to which the wing tip of his plane points. If the tip points to the blue sky between the numbered circles, one additional spin is allowed. Score is kept, and the player whose plane reaches 5,000 or 10,000 ft. first is the winner. The game can be speeded up, if desired, by counting the numbers to which all three planes point after each spin.

Any number may play the rollio game. The player puts the block on the tail of the arrow with the beveled side up and gives it a slight push with one finger. If the block stops on a line, an extra play is allowed, but if it again stops on a line, no score is made.

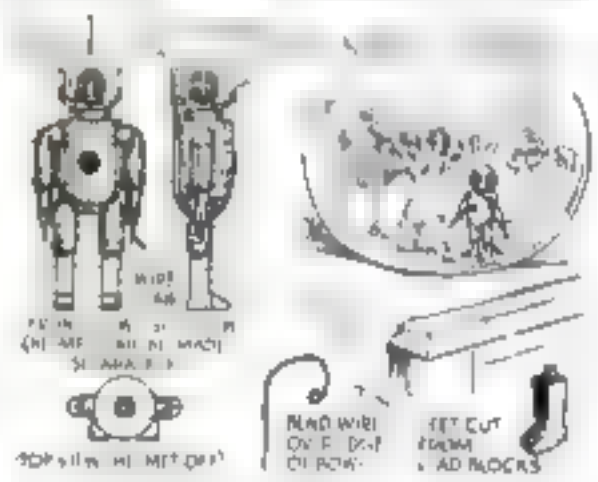
The toy airplane is lifted bodily by the wire loop and held until the base spins all the way down. It is then set on the table, and the plane will start by itself and revolve a *(Continued on page 74)*

PLANES RACE FOR ALTITUDE ON GAME BOARD

The knob is spun as shown in the drawing below

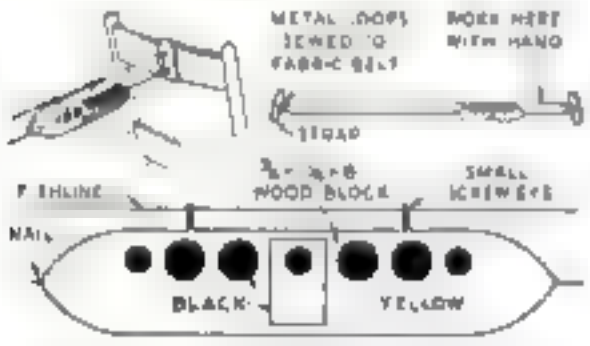
TINY DIVER PATROLS FISH BOWL

Used either as an ornament in a fish bowl



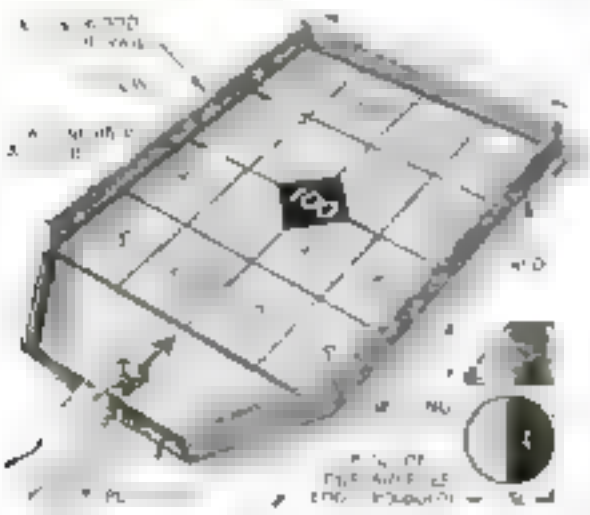
AEROCAR TRAVELS BETWEEN CHAIRS

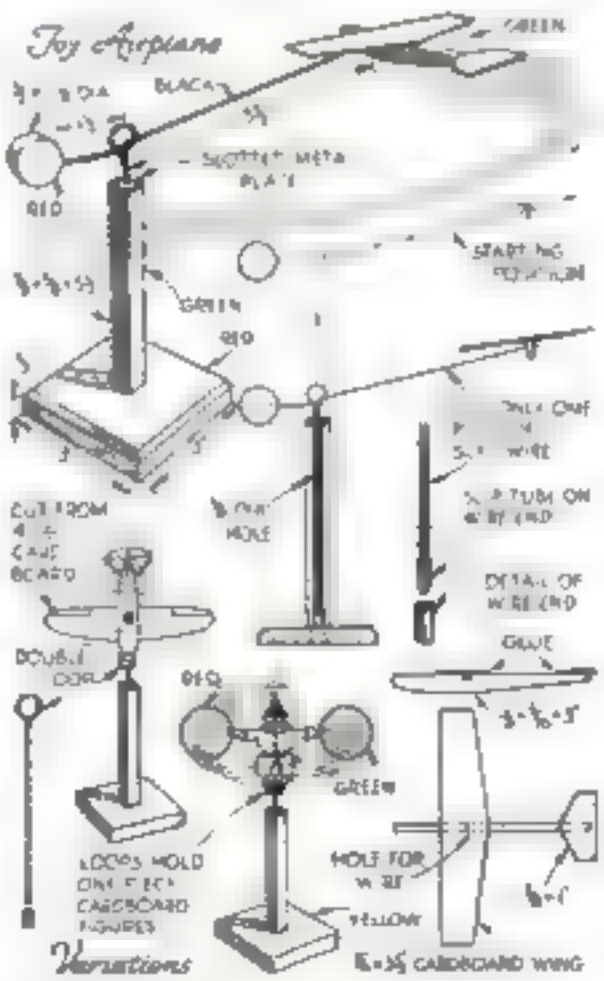
This miniature aerocar is whittled from wood and suspended from a line stunting between two kitchen chairs or any other convenient supports



ROLLIO GAME KEEPS ONE GUESSING

What makes the game shown below interesting to players and spectators alike is the way the odd-shaped rolling block flops down the board



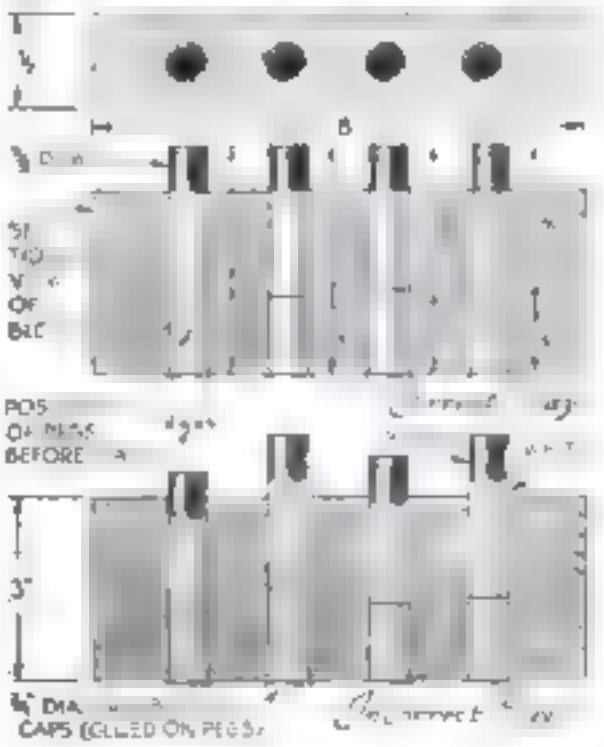


WHIRLING TOYS MOUNTED ON WIRE

Small cardboard airplanes and a large variety of other toy figures, such as a whirling clown, may be mounted on twisted wire so that they revolve in a realistic manner. The action is similar to that of the familiar spiral screw driver

CURIOUS PUZZLE MADE WITH PEGS

The push peg puzzle shown below requires eight pegs of various lengths. The four pegs having black ends are first pushed in as far as they will go, then the others are inserted opposite



Save time by using our construction kits, listed on page 8.

Translucent Modern Lamps

Two costly looking designs that any one can duplicate by using ordinary sheets and cylinders of cast resin

By
ALBERT Q. MAISEL

This desk lamp throws its light downward through an opening cut in the tubular housing, and the whole translucent tube glows beautifully

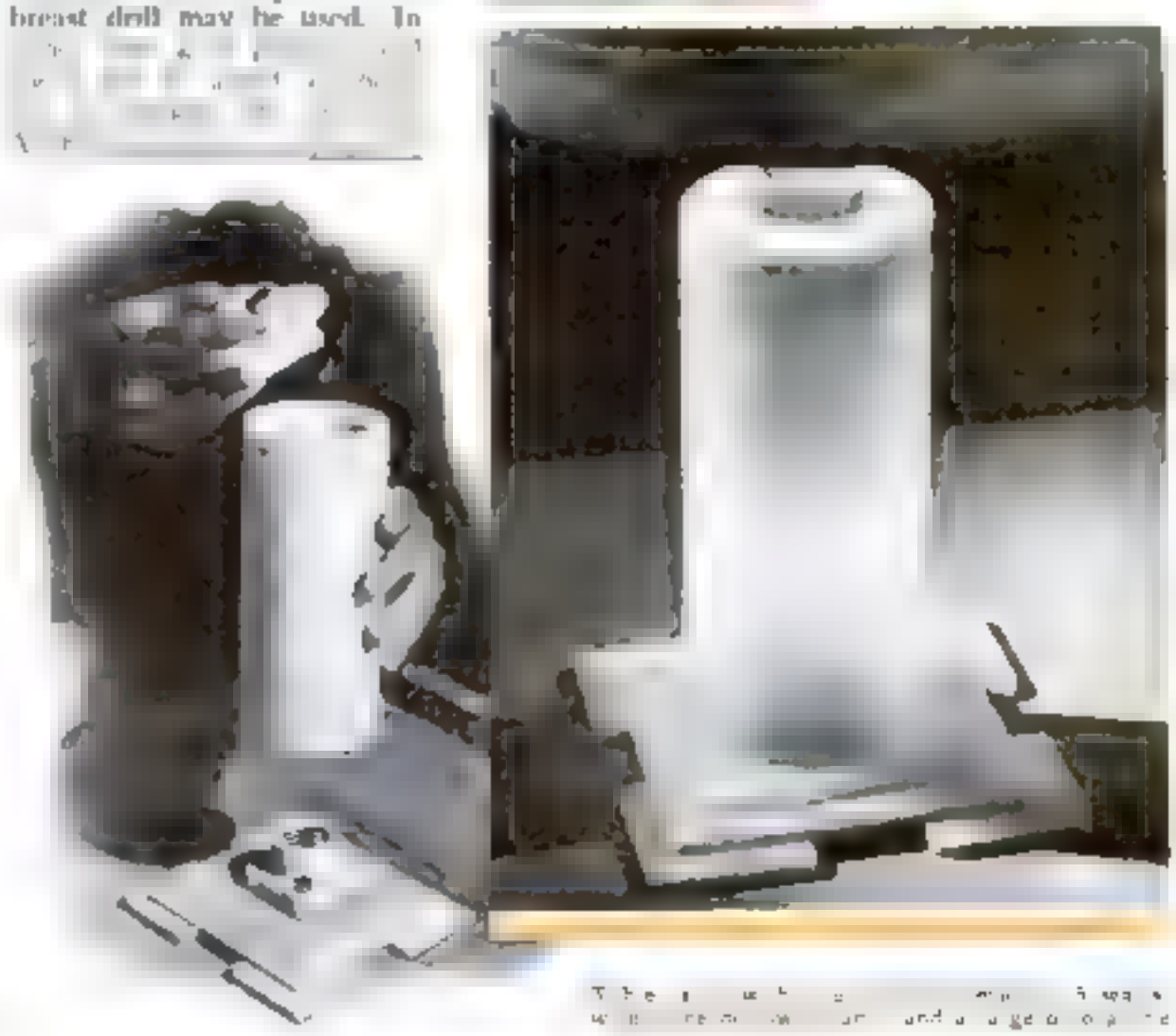
Parts of desk lamp

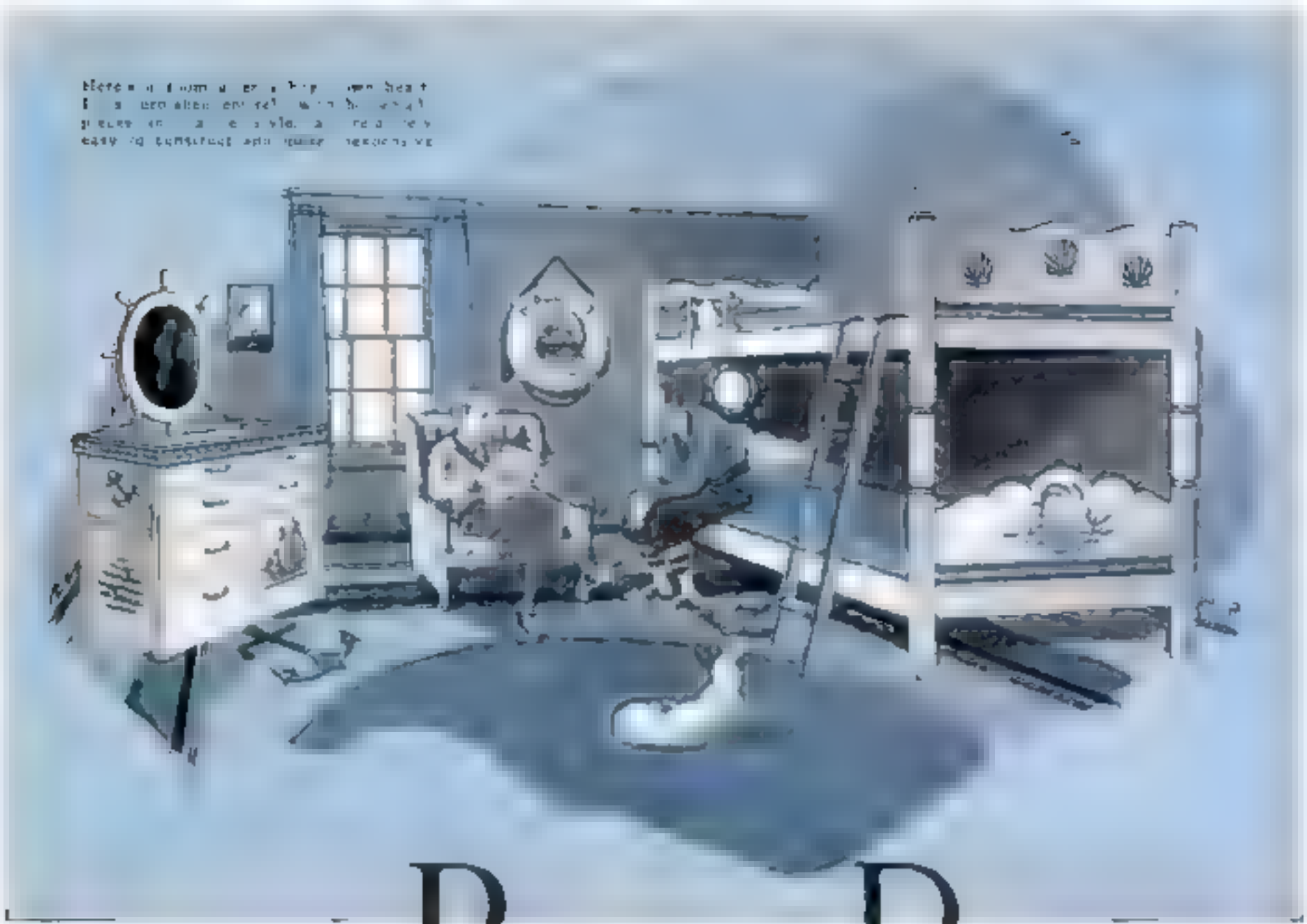
WHILE the new cast-resin plastic materials are best known for their use in making jewelry and similar small objects (P. S. M., Nov. 35, p. 59), they have another field of application that lends itself unusually well to the purposes of the home workshop. This is the field of lighting fixtures, where the unexcelled high finish, the beautiful colors, and the rare translucent qualities of cast resins combine to make possible effects that could not otherwise be obtained.

Only two standard types of casting are called for in making either the table lamp or the desk lamp shown: First cylinder castings 5½ in. in diameter and 6¾ in. in length, second, ½-in. thick sheet material which is available in various sizes up to 6 by 16 in.

For the table lamp illustrated in the lower right-hand corner of this page the following pieces are cut out of sheet material: one 4-in. square, one 4½-in. square and four 2¼-in. squares. These can be cut either with a hack saw or on a band saw.

In assembling these sections to form the base, it will be necessary to drill a number of holes, the position of which will depend on the type of socket used. Any socket similar to those shown will serve provided it is small enough to fit inside the tubular casting. Three holes should be drilled through both of the larger square sections. Two of these should correspond to the holes in the socket (which, of course, centers right above the center of these squares) and the third should be just beside the socket, for drawing through the wiring. A motor-driven drill press or a breast drill may be used. In





A PICTURESQUE BUT PRACTICAL BOY'S ROOM

Furnished Like a Ship's Fo'c'stle

By HI SIBLEY

FURNITURE of marine design is not only unusually practical for a boy's room, but much simpler to construct than the appearance of the finished pieces would lead one to imagine. Finished in a driftwood effect and with deep-sea decorations in bright colors, this bedroom set will please any young man especially if he is allowed to help his father build it.

The double-decker bed, Fig. 6, is arranged so that the top bunk can be lifted off and used elsewhere. There is ample room between the berths for dressing, and a portable ladder gives easy access to the upper berth. A sliding guard is also provided to prevent small or restless sleepers from "falling overboard." The guard simply straddles the side rail, and can be lifted off when not needed.

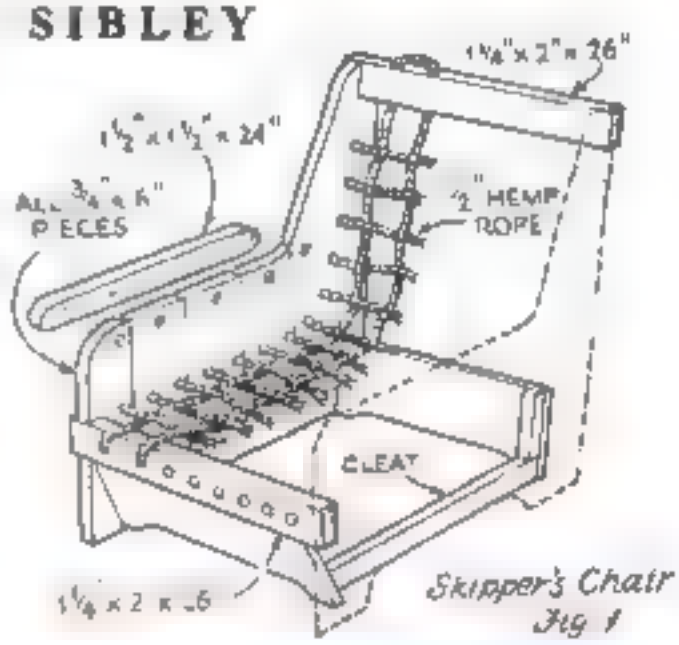
Construction details are given in Fig. 7. The corner posts are all square—3¼ by ¾ in. pine, redwood, or what you select. The ends form assembled units, consisting of head- or footboard and end rail mortised into the posts and secured with casein glue. These ends can then be attached to the side rails by means of bed hooks, which slip into slots in the bedposts. The bed hooks are standard and can be purchased at any large hardware store. Neatly fitted joints are desirable where the side rail abuts upon the post. A hardwood slat rail is screwed to the side rail as shown.

All dimensions given are net. Bear in mind that if you ask at the lumber mill for a 2 by 5-in. or a ¾ by 12-in. board, surfaced (finished) you will get something considerably smaller, so be sure to specify net dimensions when ordering material, if it is surfaced.

A comfortable "skipper's chair" is shown in Figs. 1 and 2. The sides are upright boards cleated together as shown, and with V-grooves at the joints on the outside. Bore ⅛-in. holes for the rope and weave the ropes as indicated. The ends are knotted and about 8 in. of the strands unraveled.

Port lights (Fig. 8) set into the wall at the heads of the beds are excellent for reading. These will require breaking away some of the plaster and blocking in between studs, then patching the edges to conform to the port-light frame. Frames of this kind may be obtained from a marine hardware supply house in convenient sizes.

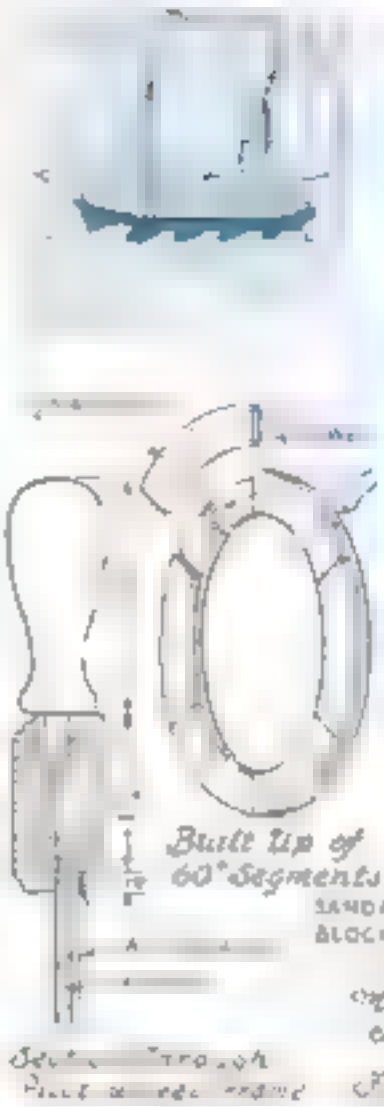
Ring buoys with the name of some favorite ship form an interesting feature of the room. They can be made of white duck as illus-

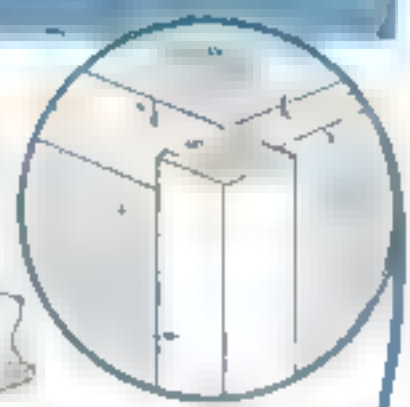


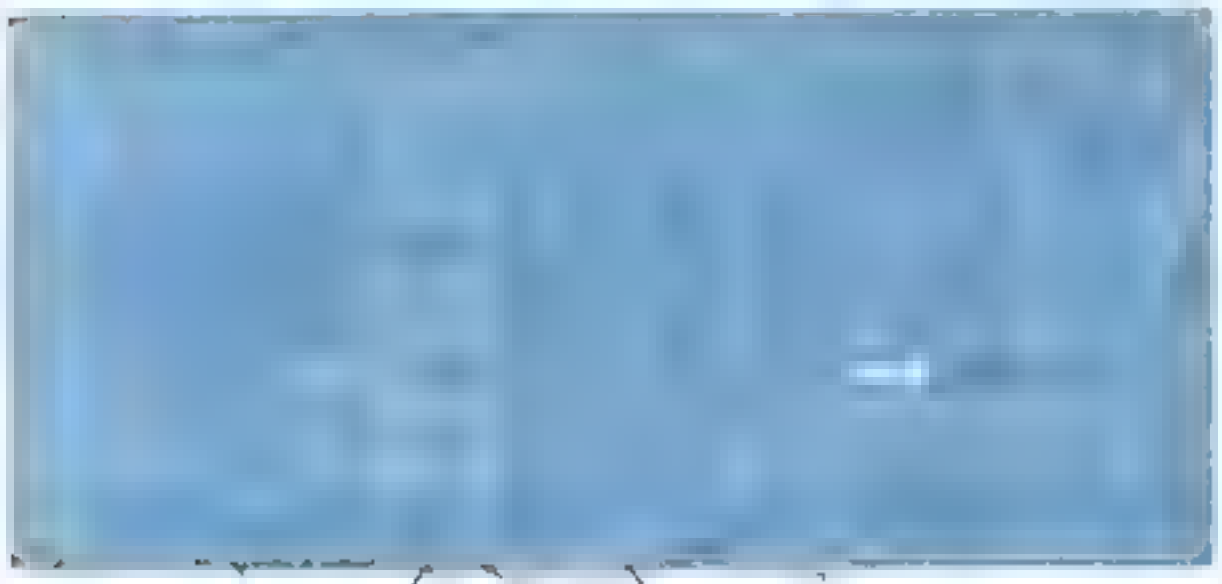
The armchair is wide and low, and the network of rope, when covered with cushions, makes an inviting and comfortable seat for long winter evenings

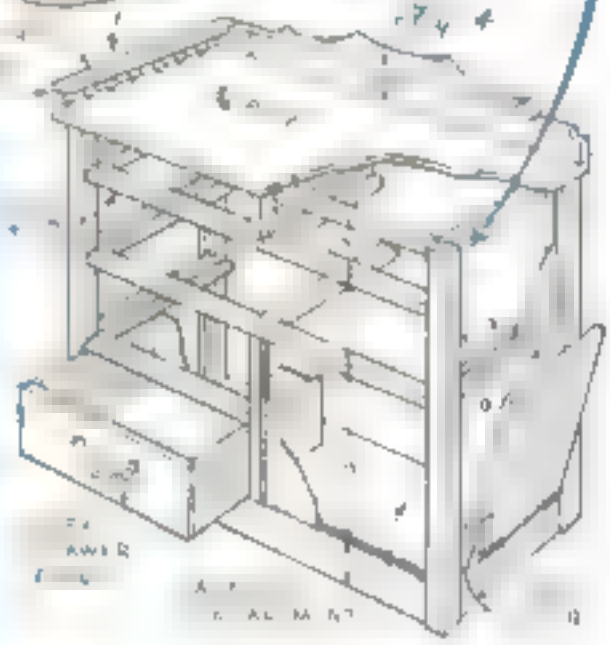
trated in Fig. 9 painted white with the name in black and the lines blue in color. Clothes hooks in the form of anchors can be sawed from plywood and painted a

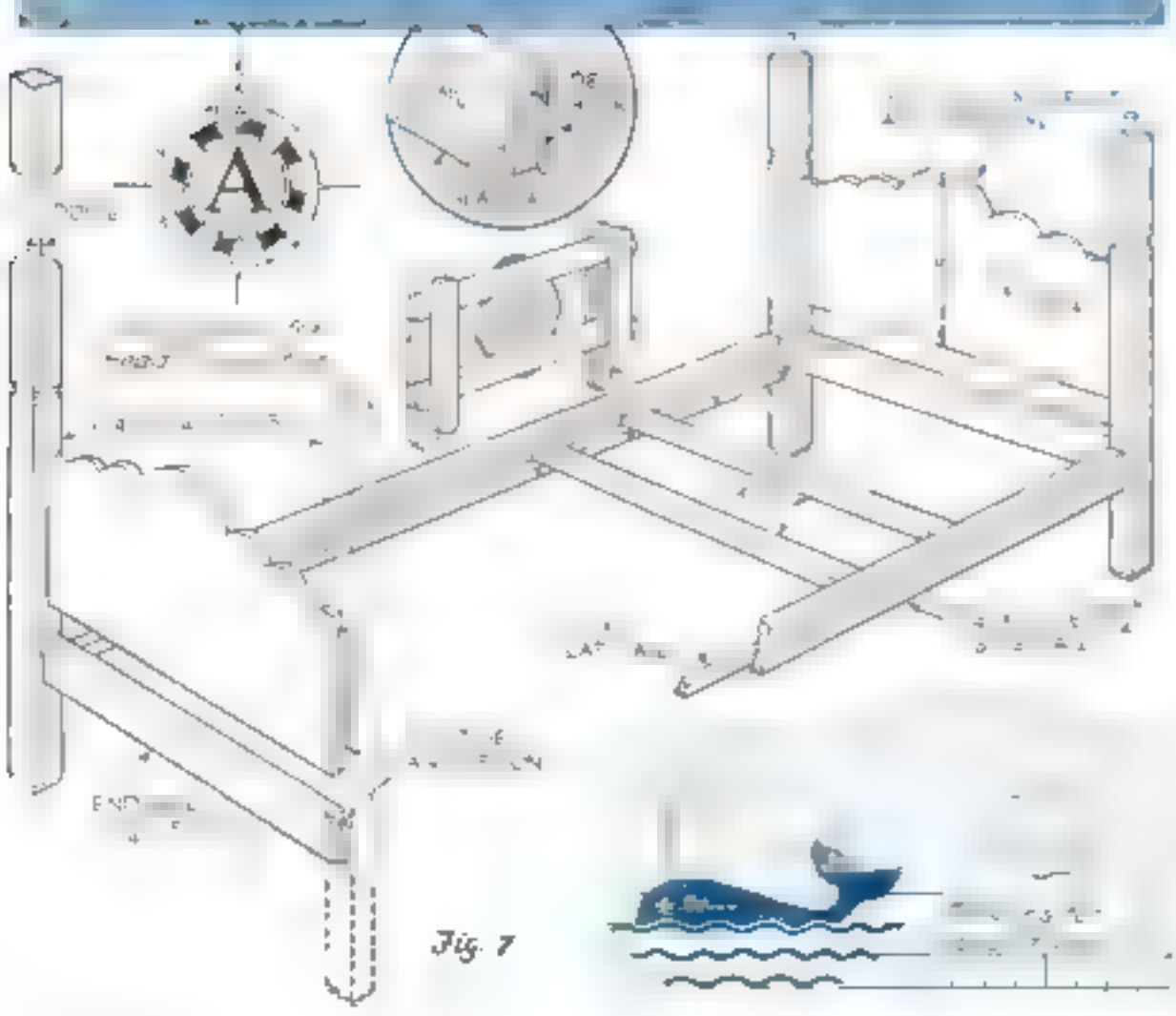
The [illegible] and 4) show assembly details of the pilot wheel. It is composed of twelve carved pieces, doweled together with seven turned spokes set in the rim. After the frame is glued up, screw it to the bench so that









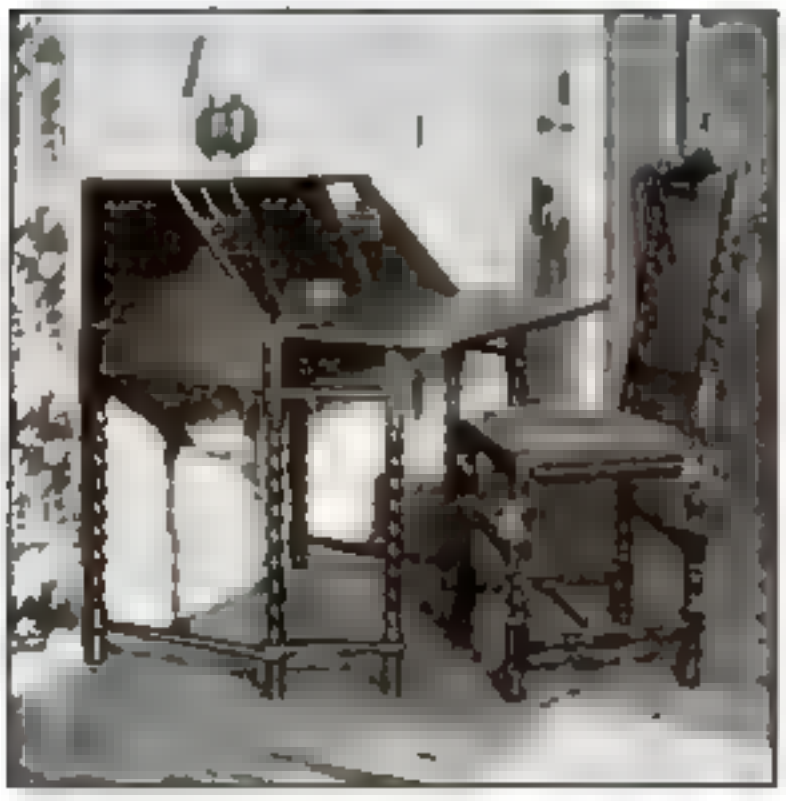


what I call a "sanding compass" made as shown, can be used for truing up the rim. Use coarse sandpaper at first, then finer grades, [illegible] with pasteboard under the sandpaper. The inside also can be trued in the same manner. If a shaper is available, give the rim a molding.

Spring hinges keep closed the truing panel to the laundry compartment of the dresser. It is opened by a piece of strap iron bent to form a pedal. Holes should be bored in the back panel of this compartment for ventilation.

Appropriate designs for the panels should be painted in bright colors. The wood should first be finished in a driftwood stain and antiqued with an application of rottenstone, or painted to harmonize with the wall and woodwork finish.

EASILY MADE SPIRAL LEGS ORNAMENT THIS



Slant-Top Walnut Desk

By Rufus E. Deering

HERE is a slant-top gate-leg desk that is not only unusually attractive in itself but also offers the amateur woodworker practice in a variety of interesting tool processes including spiral turning. Not that you need much equipment to make it. The original model was built entirely by hand, but if you own power tools, you can use them to advantage. A lathe is useful, of course, for rough turning the legs to a cylindrical shape, although even this work can be done with plane, rasp, file, and sandpaper. The spirals themselves have to be made by hand, and the tools required are only a wood rasp of half-round shape, a large bastard-cut flat file, and plenty of sandpaper.

The desk was designed to match a handmade, spiral-turned chair I built years ago (described in P. S. M., July 24, p. 73). It is fitted with gate legs in front, these support a large desk board. Well-seasoned walnut is the best wood for a desk of this style. I used wood from a discarded walnut folding bed.

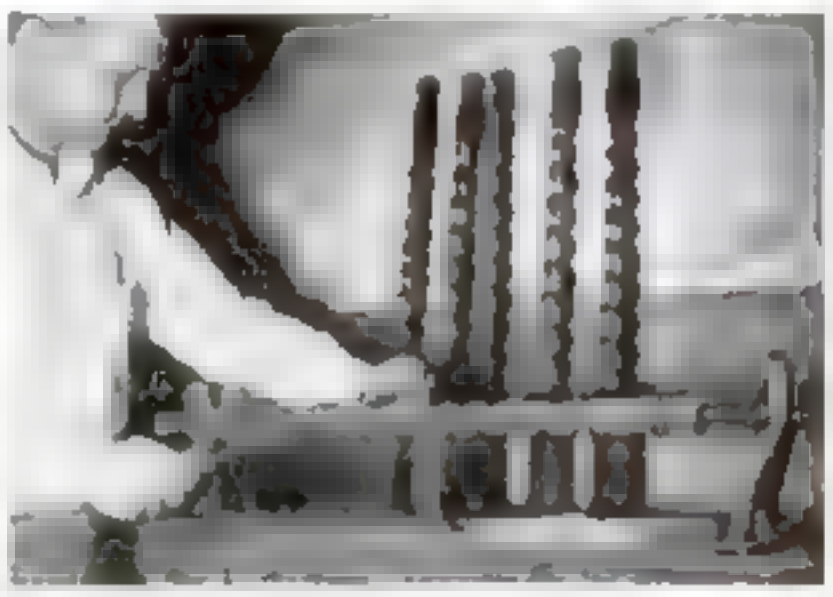
The legs were made from pieces that dressed 1¼ in. square (Fig. 1). They may be turned in one piece or made in sections, as preferred. If the legs are turned in sections as in Fig. 1, the bearings can be made without splitting the ends of the stretchers. If they are turned full length, the stretcher bearings must be split as at *b*, Fig. 4, then glued together around the bearing surface.

Before shaping the spirals, place each leg in a lathe and turn to 1¼ in. in diameter all portions of the leg that are to be spiral or round. Turn a ⅛-in. bead near the top and two near the bottom as shown. Turn the foot of each leg, and turn to ¾ in. in diameter all dowel parts. Bore holes for these in the shorter sections of the legs if you make the legs in sections.

Wrap a 1½-in. wide strip of paper spirally around each portion to be made into a spiral, leaving enough space between the edges of the strip to mark the spiral with a pencil. Then saw a ¾-in. deep groove throughout the length of the spiral mark. With the edge of the wood rasp, widen this saw cut into a V-notch. Use the round side of the rasp to work this notch into a rounded spiral depression. This forms the inside curve of the spiral turning. With the flat side of the rasp, turn off the shoulders to form the outside curve of the spiral. You need not be too particular as the sandpapering will remove all inequalities.

To bring the curve to true proportions, use 2-in. wide strips of sandpaper as shown in one of the photos. I find the best sandpaper for this is the tough cloth-backed paper used in sanding belts. Start with a coarse grade, but finish with a finer grade. Then use a fine grade of sandpaper in the palm of the hand while turning the spiral in the palm with your other hand.

Figure 3 shows the general method of assembling the legs and desk frame. The front and end members are 4 in. wide and the back member is 4¾ in. These may be plain or molded on the shaper or with combination plane or gouges, as shown in the cross section *a*. The cross members are fitted to the legs with ⅜-in. dowels, two in each end. The front cross member does not extend (Continued on page 83)



After the spirals have been marked on the turned legs, they are cut in with a saw and widened to the right shape with rasp and file

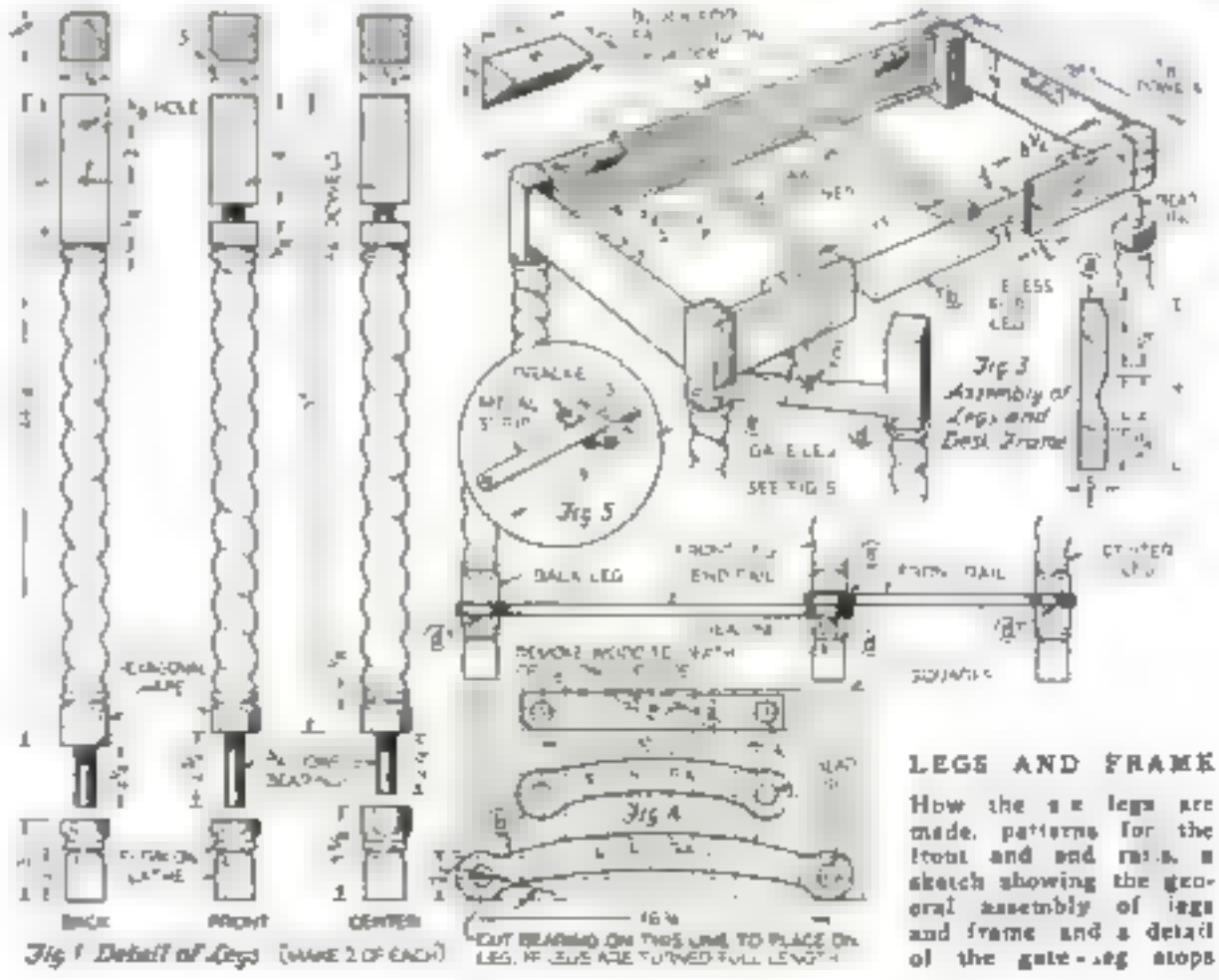


Fig 1 Detail of Legs (MAKE 2 OF EACH)

LEGS AND FRAME

How the six legs are made, patterns for the front and end rails, a sketch showing the general assembly of legs and frame and a detail of the gate-leg stops

Are you using our blueprints? See list on page 78.

It's great fun to give a circus at home with these

COMICAL *Animal Puppets*

By
Florence Fetherston Drake

WITH a clown and a comical animal or two, a whole puppet show may be staged. Animals always delight audiences, and, if made frankly humorous, they require less skill to operate than any other type of marionette.

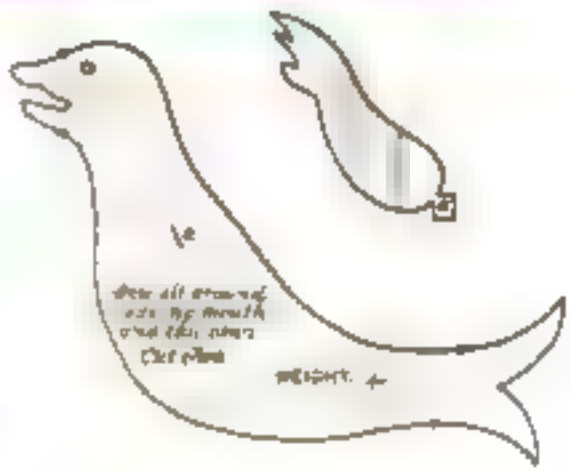
How to make a clown was told in a previous issue (P. S. M., Sept. '35 p. 58), and here are performing seals, a lion, an elephant, a dachshund, and other amusing beasts, all made from discarded inner tubes. In some cases the joints are formed with arrowhead cut-outs and slits, in others by stitches or wire. Spools or hollow cylinders of proper size are used in heads and bodies, and through these the strings are drawn. Where stuffing is necessary, cotton, excelsior, or crushed tissue paper may be used. The parts of the bodies can be sewed (overseamed) together, using large stitches so as not to tear the rubber, or they may be held with thongs cut from tubing and drawn through holes about ¼ in. from the edge and ½ in. apart, made with a paper punch of the type used by conductors.

The materials required are as follows: Discarded inner tubes (the rough side is used outward in most cases), old bathing caps, colored rubber balls, old hot-water bottles, and any other available scraps of rubber; bits of fur and feathers; spools; cigar boxes from which to make controllers; carpet thread for stringing puppets; material for stuffing, such as cotton wadding, excelsior and crushed tissue paper; buttons, beads, and spangles for eyes and harness ornaments; rubber penciled eyes in various colors from which to cut rings for eyes; lead shot, sheet lead, or sand to weight parts; nails, brads, and small screw eyes.

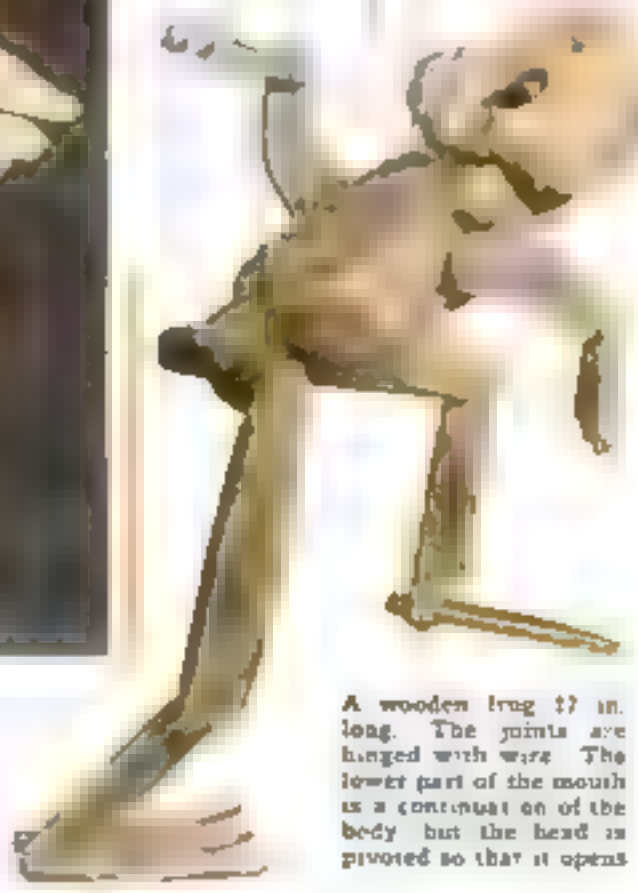
Few tools are needed. A drill, scissors, ruler, knife, punch, hammer, coping saw, and large needle are sufficient.

Performing seals are the simplest to make as they require only four main pieces each, as shown in the drawings. Cut slits in the body for the fins. Attach eyes, which may be either beads or rings, then sew the body along the back except for about 1 in. of the head and 2 in. at the tail. Sew the underside for a similar distance, from head to tail after pushing the padding material in through this opening. It is advisable to weight the tail with a piece of sheet lead, which may be held in place by sewing through the tail to form a pocket.

Performing seals that toss the ball from one to another in an amusingly realistic manner. All the puppeteer has to do is to manipulate the right hand stick. Right: The pattern



Dachshund made from inner-tube rubber. The visible part of the body is one piece, but there is also a bottom piece, stitched on. Spools are inserted crosswise between the legs (front and back). A standard animal controller is used.



A wooden frog 17 in. long. The joints are hinged with wire. The lower part of the mouth is a continuation of the body, but the head is pivoted so that it opens.

The control to which the strings are tied is a dowel stick about 10 in. long. The second control is 12 in. long, and to this is tied the two strings which pass through the hole in the wooden ball. The end of one of these strings is sewed to the nose of one seal; the second to the nose of the other seal. By tipping this stick, which should be held in the right hand, the ball will bounce up and down from one nose to the other in the most surprising way.

It is advisable to wax all threads. Not only does it make them stronger, but also less likely to (Continued on page 92)

HOW TO Whittle *Mère Marthe*

A QUAINT OLD PEASANT WOMAN

This figure was made with a small saw and a sharp pocketknife by a method that removes most of the difficulties

By E. J. TANGERMAN

AS A MANTEL companion to Skipper Sam, whom you learned how to whittle in a previous issue (P.S.M. July '35, p. 63), here is Mère Marthe, sweet old Swiss peasant lady on her way to church. She is authentic too, for Swiss peasants first carved the figure.

You'll require a bit of straight-grained soft wood (white pine or basswood) 2½ by 2½ by 5½ in. The 1-in. greater thickness required than for the Skipper is a result of her billowing skirt and aged stoop. Lay out ½-in. squares on the front and left side of the block just as you did in cutting the blank for the Skipper, but this time sketch in the outline of the blank as shown by the views at left of Fig. 1.

Saw in first on all the horizontal lines, then the lines at the back and sides of her head. Next saw part way on all remaining lines from the side, then from the front, with the exception of the lines for the feet, which can be cut all the way in. (Don't cut too far on the other lines, or you'll lose your laid-out guide lines.) Marthe's left side can now be cut free entirely, and after this the other lines can be sawed in their full lengths, but remember to cut the back lines out first.

On the blank, which will now look like Fig. 2, sketch the old lady's face, her kerchief and the outlines of her arms and apron. Templates drawn from Fig. 1 will help in marking the position of the arms and hands exactly. Next begin to round up the head and skirt as in the photograph of the partly finished block, and keep in mind the dangling right arm and handkerchief in the hand. The feet can be finished next, as shown in Fig. 3. Study that sketch carefully before you begin to cut away wood. Notice that both feet turn slightly outward and that the right foot is advanced to aid the figure to stand steadily.

From there on, it's all a matter of finishing details, just as with the Skipper. Delicate parts such as the hands, face, prayer book, and kerchief knot should be finished last. Groove the skirt into folds, outline the apron and the handkerchief, cut in grooves as shown in Figs. 1 and 4 to simulate the folds of cloth at the neck, elbows, kerchief, and handkerchief, and the old lady is complete. If you want to avoid cutting and shaping eyeballs, simply leave a depression under the eyebrow and paint in an eye like that in Fig. 5. Make a black arc and a spot for the pupil, and outline the pupil with white for the iris.

Use soft colors in painting this old lady—garish or bright colors will ruin her appearance and make her look like a cheap toy. Oil paints are best for this piece. In mixing the paint, add a little—a very little—of the complementary color. In other words, to the yellow for her blouse and skirt add a tiny touch of purple (red and blue); to the blue for her apron add a touch of orange (red and yellow), and to the red of her handkerchief and kerchief add a touch of green (yellow and blue). Outline her handkerchief in white, and put narrow, dull, vertical stripes of red and white alternating about ¼ in. apart on her apron. Her hair is white, her hands and face a dull flesh color, eyes black outlined in white, her mouth red. A touch of

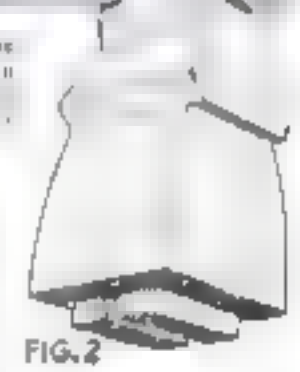


FIG. 2

knife or paintbrush will vary her expression as you wish. Her shoes and prayer book are black, the latter with a gold cross and gold edges.

Mère Marthe may be made twice her indicated size by using ½-in. squares, or half her size with ⅛-in. squares.

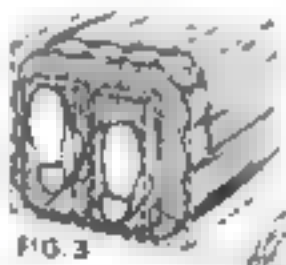


FIG. 3

FIG. 4

FIG. 5

The dark left sides of upper part of figure and the features

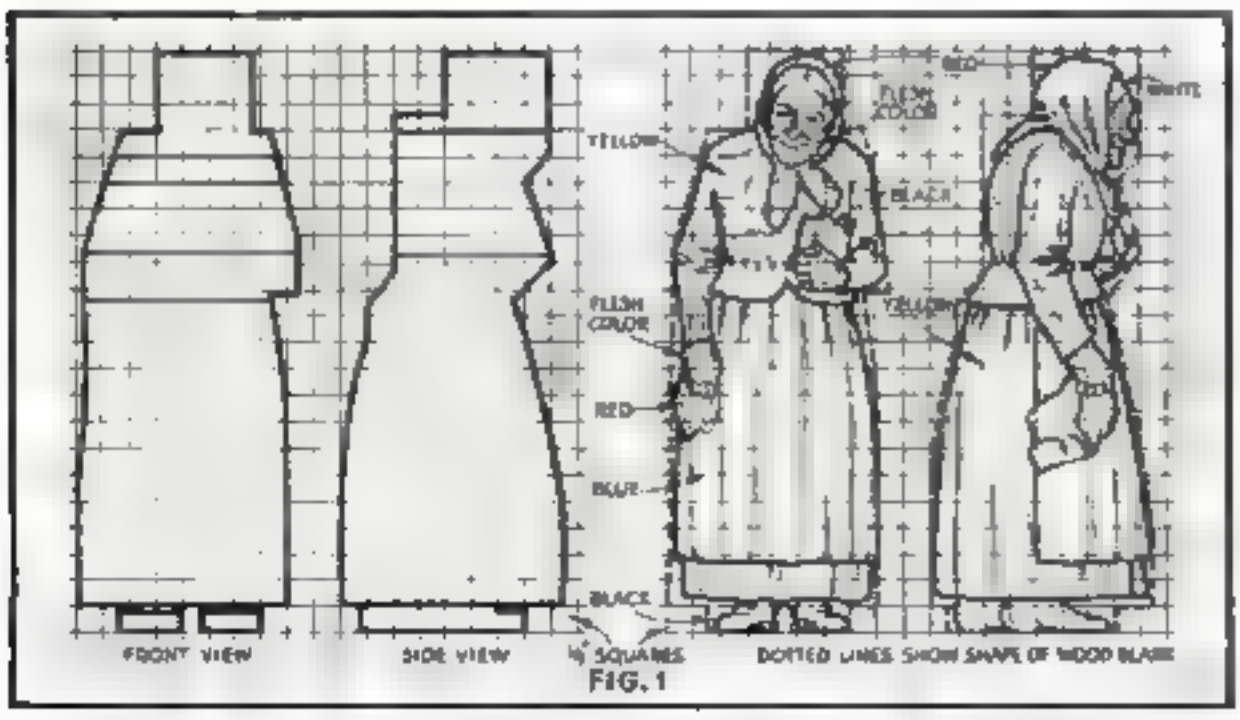


FIG. 1

The two views at left show the blank (see also Fig. 2); those at right, the finished figure

NEW METALLIZED PAPER AIDS MODEL MAKERS

A NEW and useful material for model makers is the aluminum-faced insulating paper now obtainable at many builders' supply houses. Neat name plates for models can be typewritten directly on the aluminum, without using the ribbon. A coat of dull-finish black paint is brushed on, allowed to dry for about ten minutes, and then wiped off except in the type indentations. When thoroughly dry, the plate is polished and glued to the base board of the model.

Riveted metal side plates for boat models may be made by embossing imitation rivet heads on a piece of the metalized paper. In this case the paper is inserted with its metal face inward, against the typewriter roller, and the period key is used.—MALCOLM DAVIES.

FAMOUS AVIATORS TELL WHY CAMELS ARE MILDER

Lieutenant Commander Frank Hawks, U.S.N.R. (*left*), holder of 214 speed records and the Harmon Trophy, says: "I've been flying for 19 years and smoking Camels almost as long. Making speed records tests the pilot as well as his plane. As the athletes say, Camels are so mild they don't get the wind. And they never upset my nerves. Camel must use choicer tobaccos.

"Camels don't get your Wind" (Frank Hawks' way)

"I must take every precaution against jangled nerves," says Mrs. Theodore W. Kenyon, sportswoman pilot (*right*), "so I smoke Camels. They are the mildest cigarette I know. I can smoke Camels steadily and they never upset my nerves."

"They Never Get on Your Nerves"

"I smoke Camels all I want," says Colonel Roscoe Turner (*right*), who set the transcontinental speed records both ways. "I enjoy Camels more. And because of their mildness they never tire my taste. A speed flyer uses up energy just as his motor uses gas. After smoking a Camel, I get a 'refill' in energy—a new feeling of vim and well-being."

"Get a Lift with a Camel"

"I appreciate the mellow flavor of Camels," says Sir Charles Kingsford-Smith, the transpacific flyer (*right*). "They refresh me when fatigued, and Camels are so mild that I can smoke any number without throwing my nerves off key."

"They Never Tire Your Taste"

COSTLIER TOBACCOS!

● Camels are made from finer, MORE EXPENSIVE TOBACCOS—Turkish and Domestic—than any other popular brand.

(Signed)
R. J. Reynolds Tobacco Co.
Winston-Salem, N. C.

Change Now to America's Favorite Winter Oil!

Be Ready for Cold Weather Driving with an Easy Starting, Fully Protected Motor

DRIVE in today and get Mobiloil Arctic, the great new winter oil that won the approval of millions of car owners last winter!

Made by Socony-Vacuum's Clearosol Process, Mobiloil Arctic was introduced last November to give easier starting, better engine protection, longer mileage.

Public acceptance and acclaim came immediately. Sales far exceeded expectations. Positive proof that Mobiloil Arctic does all that is claimed for it!

Go to your Mobiloil dealer today —change to Mobiloil Arctic (20W) or Mobiloil Arctic Special (10W), whichever your car requires. And while you're there get Mobiloil CW —the special winter gear oil, for easy shifting gears.

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STOP AT YOUR *Mobiloil Dealer* FOR AMERICA'S FAVORITE WINTER OIL

1 EASY STARTING—
Mobiloil Arctic will give you quick, easy starting and instant lubrication at low temperatures.

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Mobiloil Arctic resists heat thins its body at high engine temperatures—gives full protection to moving parts.

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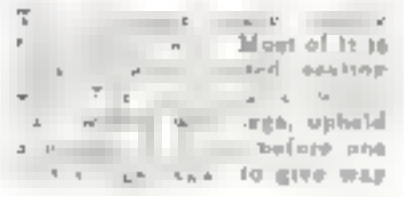
Mobiloil Arctic stays on the job—lasts longer. Actual users of this winter oil report from 25% to 50% greater oil mileage.

Mobiloil Arctic

GARGOYLE Mobiloil — SOCONY-VACUUM

Everlasting Doll Furniture

A Whole Set Made in a Single Evening from Discarded Wire



By CHARLES VANUCK

DOLL furniture is usually limited as to size, finish, and variety of design and is often of fragile construction. The type illustrated, however, is very sturdy and easily repaired, and an entire set can be constructed and finished in a single evening. In fact, all these pieces were made from the wire from a discarded electric light line and an old radio aerial. The expense was limited to ten cents for rosin-core solder and twenty cents for sealing wax only half of which was used.

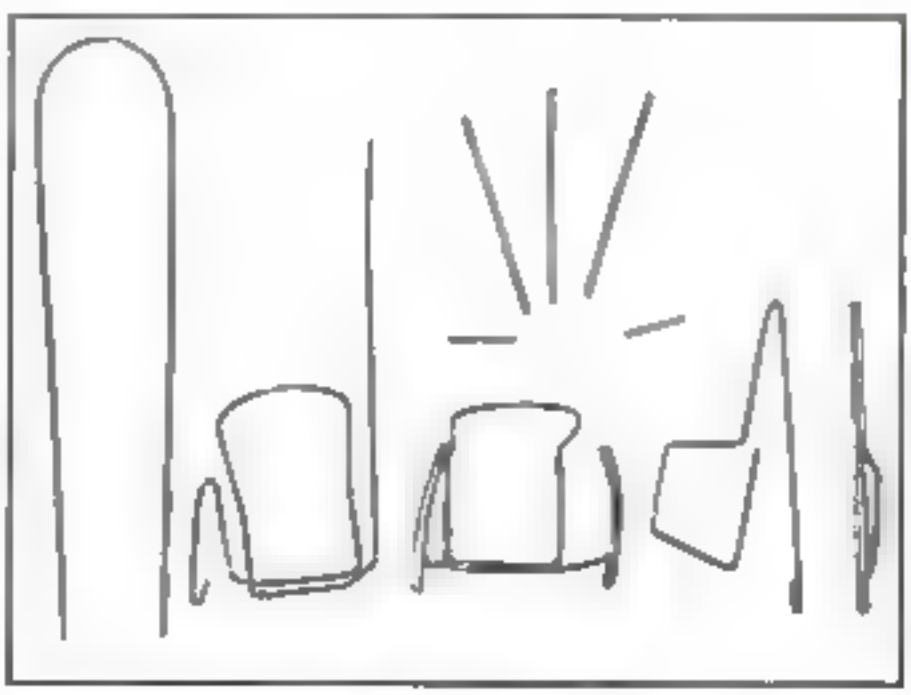
A length of hard-drawn copper aerial wire can be purchased for twenty or twenty-five cents if you have no discarded wire of at least No. 12 gauge handy. If you use old wire, put it in the furnace to burn the insulation off and then brighten it up with a piece of emery cloth or sandpaper. Cut it into short lengths for easier handling and straighten it by drawing it between three nails driven into a board and spaced about 1½ in. apart.

To construct the bed, first bend two identical rectangles for the main bed frame, space them about ¾ in. apart, and connect them with long V-shaped stiffeners as illustrated. Next bend the two pieces that will form the head- and footboards and solder them securely to the box section. Heat the joint first with the soldering iron and then apply the solder, giving it plenty of time to penetrate the joint and burn out the flux. You may want to wear an old glove on the hand that is holding the wires because copper transmits heat rather rapidly. The head- and footboard decorations are next fastened in. Start with the central bar, soldering it first at the bottom, and leave the upper end of the wire long enough for handling without getting too hot. Then cut the wire carefully to length and solder. The other bars follow. Solder one on each side of the central bar and move to the next post. Trim the legs to equal length and the bed is finished.

The rocking armchair, if properly proportioned, will be attractive enough to serve as an ornament as well as a toy. Start with a straight piece of wire bent in the center to form the top of the chair back. Be careful of the radius because it must be absolutely true. A spool or broom handle may be used as a jig. Determine the height of the back and then bend the back up to form the seat. Holding the wire with a scale or a piece of wood will help to keep the back straight. The two ends are then bent to form the seat. The wires should cross each other at the front edge of the seat; they are then bent upward until they are almost vertical to form the supports for the arms of the chair. Now bend each wire back, parallel with the side of the seat to a point about ¼ in. beyond the upright part of the back. Bend the wire back sharply upon itself and pinch the bend tight with the pliers. The wire is carried forward to ⅛ in. beyond the upright arm support and again bent back sharply and trimmed where it meets the upright. Carefully radius the arms until the rear ends just meet the back, and solder them in place.

The rockers are made in the same way as the arms except that there is, of course, a separate piece of wire for each rocker and support. Solder the rocker supports to the seat of the chair, keeping the rocker supports inside the square that forms the seat. Fill the space between the doubled wires of the arms and rockers with solder.

Now assemble the three bars in the back and also the small support under the center of each arm. This support takes the strain off the soldered joint at the rear end *(Continued on page 104)*

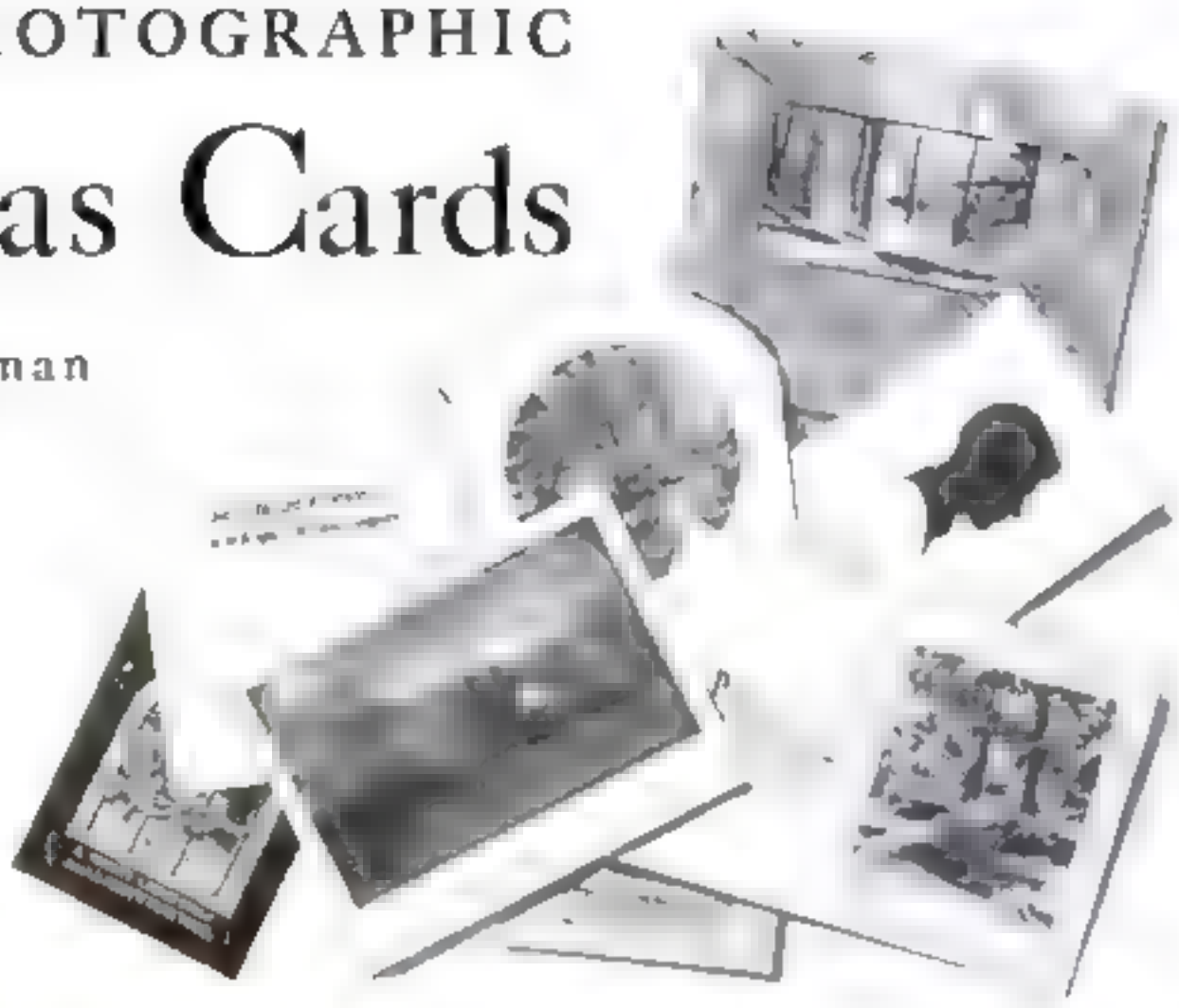


An unusually decorative rocking chair. At the left is shown the method of bending the wire parts

Novelties in PHOTOGRAPHIC

Christmas Cards

By Ivan C. Luckman



ANY amateur photographer can easily prepare his own Christmas cards and make them so attractive that they will almost cease to be mere greetings and become gifts.

After you have decided on the approximate size and color of your card, visit a stationery store and choose an envelope that will fit in with your scheme. Colored and fancy lined envelopes will harmonize well with almost any card except white, while if you have decided to use a white or hand-tinted card, you will want to use a white envelope. Envelopes are stocked in a number of standard sizes, so you will have to plan the final layout of your card to fit one of them.

Photographic printing papers are also stocked in a great many surfaces on white, natural, cream, or buff paper. Choose a dead matte finish on a smooth or slightly pebbled base. White stock should be used if the view negative chosen shows a winter scene. Silhouettes also should be made on white paper. Summer or autumn scenes will look well on cream or buff paper, while portraits, either formal or informal, will look best on ivory stock. Autumn scenes are attractive if redeveloped to a rich sepia.

There are three main sources from which you can get the message or greeting. It may be entirely hand written or printed with India ink upon smooth white paper, you can copy the greeting from an old Christmas card, or you can have a printer make one copy to your specifications for a small amount. If you elect to write your own message, write or print it somewhat larger than you want it to appear on the card. When it is copied down to the proper size, all little imperfections will disappear.

Place the original message on the wall or other rigid support and, with the camera on the tripod, focus carefully on the ground glass. It is best to use a magnifying glass to insure accurate focusing. Make the negative on positive or contrast film, and be sure that the copy is evenly illuminated from each side. If two photoflood lamps are placed about two feet from the copy, an exposure of about one second will be approximately correct with the lens opening set at F/16. Develop the negative in a contrast developer. The following is a very satisfactory one.

Water	8 ounces
Sodium bisulphite...	90 grains
Hydroquinone	90 grains
Potassium bromide	90 grains

When ready to use, add

Caustic soda	164 grains
Water ...	...8 ounces

Development should be complete in from three to four minutes at 68 deg. F. Inasmuch as positive film is relatively insensible to light, it can be developed by inspection in the light of a bright red lamp similar to that used for bromide paper. What you are after is a negative with perfectly clear or transparent letters on an opaque background.

The view negative may be any negative from your collection, or you can make one that will be really different and original by means of table-top photography. Some absorbent cotton and salt for snow and a few inexpensive tiny houses, animals, and figures such as are used to ornament Christmas trees will furnish the "props" for any number of scenes. Such settings should be lighted mainly from one side so as to throw long shadows, and the negative should be developed in a soft-working developer.

The printing mask is made from any opaque, thin paper such as that used for wrapping sensitive photographic materials, or you can use thin red cellaloid to make the aligning and registration easier. For the simpler

Continued on page 70

How the masks are arranged for printing a card with two photos like that illustrated in upper right corner of this page. The masks are hinged at opposite ends of the glass. Note the mask for protecting the small picture while the larger one is being printed. One mask projects as shown at right while the other mask is in use

Here's a Picture you can make *Tonight!*

LONG fall evenings bring gay times at home. It's a side of life that your camera shouldn't miss. Make pictures tonight. And certainly Thanksgiving time when the family foregathers.

Any camera that can be set for "time" will do. Get Mazda Photoflash or Photoflood bulbs —load your camera with Kodak "SS" Film, particularly adapted to night picture taking, or Kodak Verichrome Film which will also give very good results. Follow the diagram and information given here to make a picture like the one shown, with Photoflash.

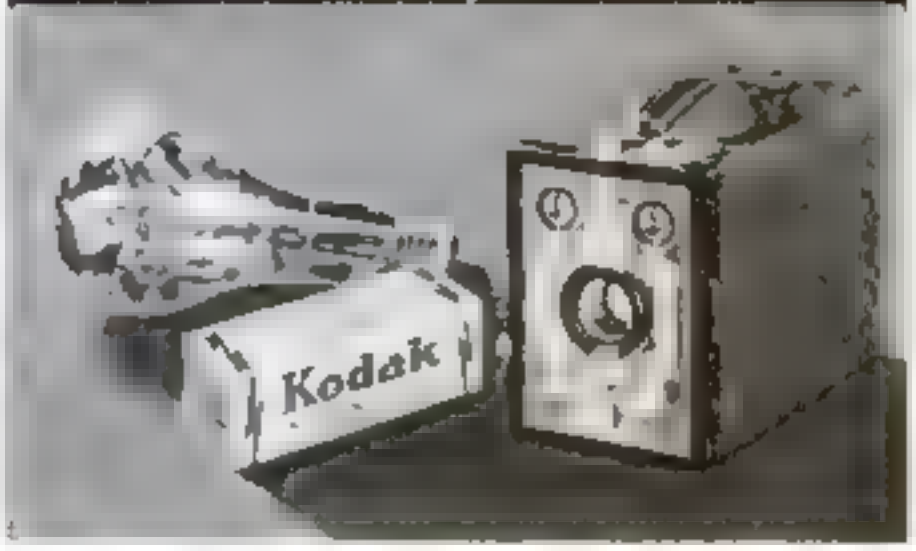
If you have a camera with a fast lens . . . / 6.3 or faster —you can make snapshots—instantaneous exposures — indoors at night. Use two or three Mazda Photoflood bulbs, load your camera with Kodak "SS" Film. Open the lens to *f*.6.3—set for 1/25 second. Hold the camera in your hands just as you would outdoors . . . then snap the picture.

Night pictures with any camera . . . Any camera that may be set for "time" will make quick time exposures at night with Mazda Photoflood bulbs or make Photoflash shots as indicated. Photoflood bulbs cost 25¢, last for many pictures. Load with Kodak "SS" or Verichrome Film. See your dealer or write for folder.

Here's how you do it

Load with Kodak "SS" or Verichrome Film. Place your camera on firm table, eight feet or so from subject as shown in diagram. Hold Photoflash bulb, in reflector above and to the side of camera. Set camera for "time." Open shutter—flash bulb—close shutter. That's all there is to it.

Here's all you need



KODAK "SS" FILM or Kodak Verichrome Film Photoflash Bulbs—give a brilliant, instantaneous flash that stops all ordinary action — cost but 15¢ each. Any box or folding camera with "time" adjustment will do. The picture at upper left (enlarged) was taken with BROWNIE SIX-20 —dependable for pictures indoors or out. For 2¼" x 3¼" pictures—$3.

Ask your dealer about the current $2500 Prize Contest for Night Pictures. All amateur pictures taken eligible.

FREE FOLDER

Complete instructions on night photography . . . suggests subjects . . . tells how to make pictures at night with any camera that can be set for "time" . . . Eastman Kodak Company, Rochester, N. Y.

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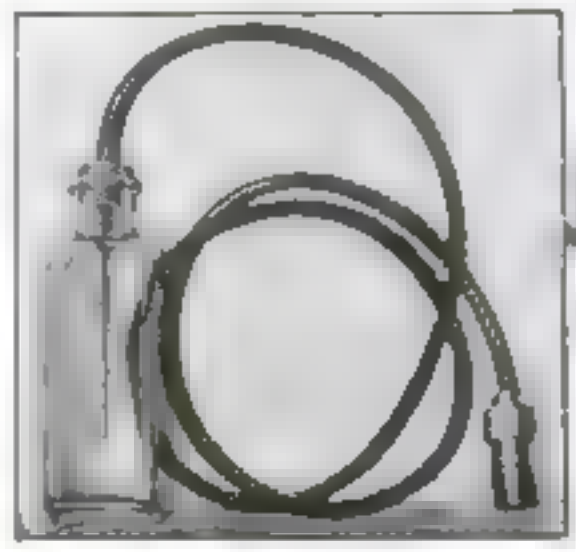
P. S. 12-35

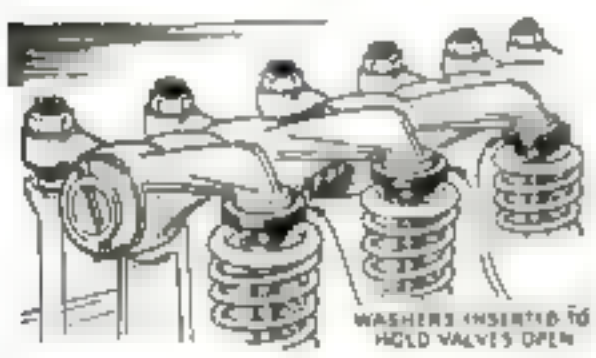
TIME-SAVING KINKS FOR CAR OWNERS



This easy-to-assemble timing device consists of a spark plug, brass tubing, rubber hose, and a bottle

FROM an old spark plug and a few other odds and ends, you can assemble a piston-dead-center indicator that makes timing a car's ignition a one-man job. First remove the porcelain from the spark plug and solder a short length of brass tubing into the opening in the top of the metal shell. The tubing should be a snug fit inside a piece of rubber, windshield-wiper hose. Next, obtain a small bottle, make two holes in its cork—one to take a second piece of brass tubing, the other to serve as an air hole—and fill the bottle three-quarters full with water. In timing a motor, screw the plug into number one cylinder and turn the crank until air issues from the hose, indicating that the piston is on the up stroke. Then attach the other end of the rubber hose to the bottle, continue to turn the crank slowly, and watch the air bubbles that form in the water. When the last bubble leaves the tube in the bottle, it shows that the piston is at top center and the distributor can be set accordingly with the aid of a synchronizing tool of the type marked in degrees. Simply rotate the distributor either before or after top dead center the number of degrees specified by the manufacturer. The bottle, placed on the top of the radiator shell, can be watched easily as the crank is turned. Care must be taken, however, not to turn the crank more than that required to force the last bubble from the end of the tube into the bottle. If the piston is allowed to start its down stroke, water will be sucked into the cylinder.—E.A.L.

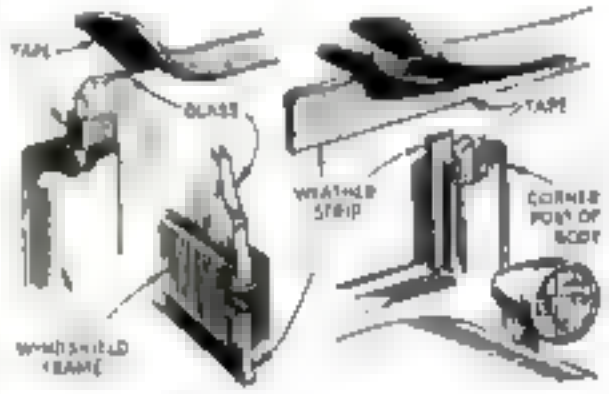
Relieving Compression for Bearing Repairs



Washers between rocker arms and valve stems relieve compression for work on the bearings

WHEN working on the main or connecting-rod bearings of an overhead-valve motor, the usual practice is to relieve the compression by removing the spark plugs. A much easier and quicker way is to insert thick washers temporarily between the rocker arms and the valve stems. This will keep all of the valves partly open and allow the crankshaft to be turned easily. If washers of the right thickness are not available, strips of leather, inner tube, or cardboard can be used with equally good results.—J.N.

Silencing Windshields



WITH a roll of rubber tape and a tube of tire cement it is easy to make a roadster windshield rattleproof and weather-tight. Placed around the edges of the glass, the tape holds the windshield glass snugly in the frame. Now weatherstripping is made by cementing two or more strips of the tape over the edge of a third strip to form a thick backing as shown in the sketches above.—F.A.B.

Installing an Auto Heater in Cramped Space

THE PROBLEM of installing a large car heater in a space much too small for it was solved by one ingenious car owner by cutting the heater in two. As shown in the photographs, the fan and radiator assembly of the hot-water unit was mounted inside the car while the electric fan motor was fastened to the opposite side of the engine-compartment wall. To do this, it was necessary only to cut several inches from the original mounting brackets and to provide an extension for the motor drive shaft. Five holes were drilled through the motor wall, two large ones for the water-connection pipes, two small ones for the mounting bolts, and a medium one for the fan shaft. This arrangement also makes the motor readily accessible for oiling and repair.—W.E.B.

To save space, a car heater can be installed in two parts, the radiator in the car (left), the motor in the engine compartment

Cure for Porous Tubes

NOTICING how rubber stoppers on bottles containing gasoline swelled up when they were removed from the bottle and exposed to the air, a car owner recently decided to try gasoline as an emergency cure for a porous tire tube. Removing the valve, he injected about a teaspoonful of gasoline into the stem with a medicine dropper, sloshed it around, and finally inflated the tire. Although only an emergency repair, the tube stood up for many months.—E.N.

NEW 1936 "DELTA"

MOTOR-DRIVEN TOOLS

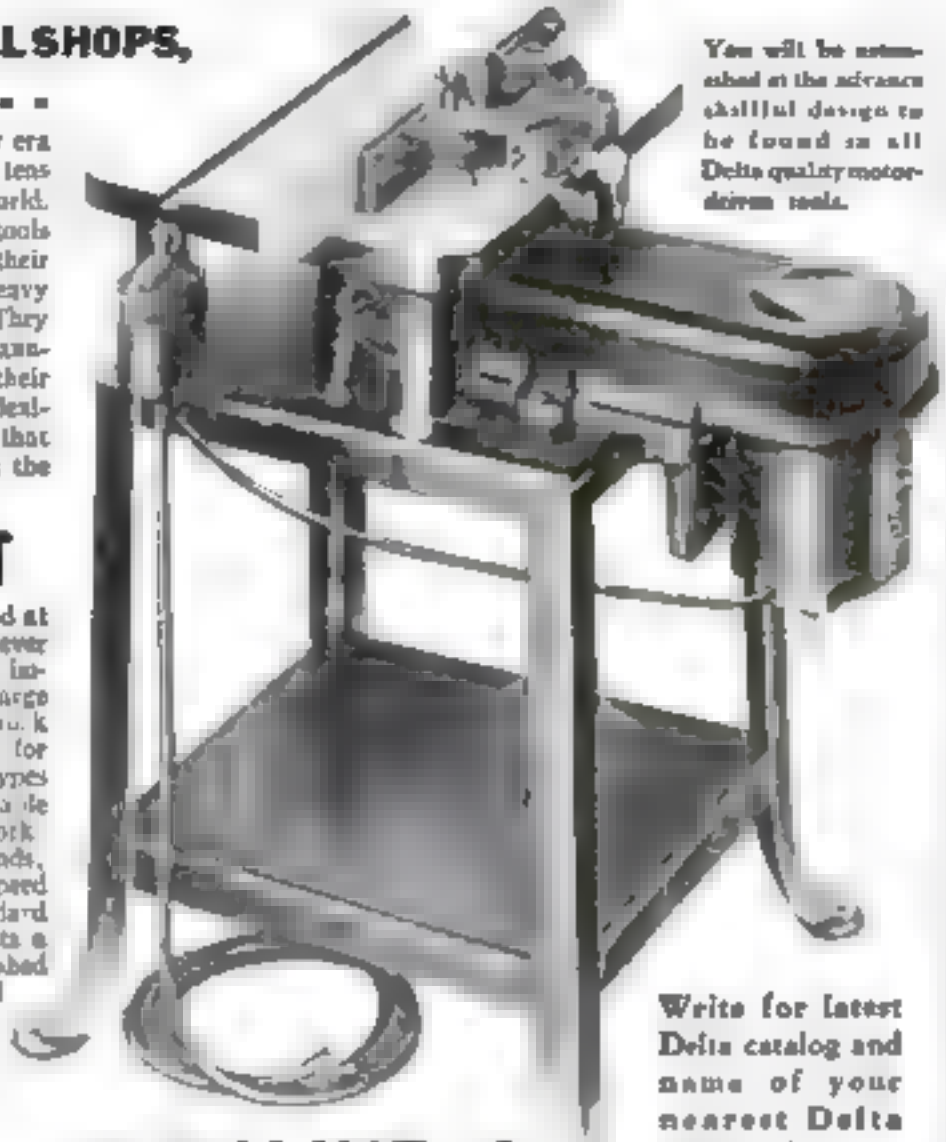
FOR FACTORIES, SMALL SHOPS, HOME WORKSHOPS . . .

Delta quality tools have brought a new era to users of motor-driven equipment in tens of thousands of shops all over the world. These sturdy, efficient, motor-driven tools are saving time, money and labor for their users. Delta tools are built to stand heavy strain of continuous production work. They are being used by some of the largest manufacturers in the country because of their accuracy, quality construction, and flexibility. Yet their initial cost is so low that they are well within the reach of even the home workshop owner

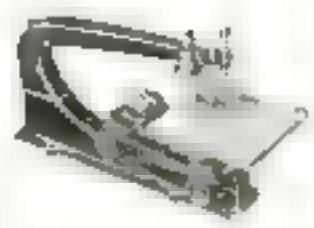
NEW SHAPER UNIT

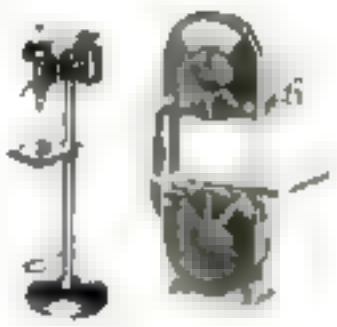
here illustrated is one of the simplest and at the same time most complete Shapers ever designed for the workshop. Some of its important basic features are: **1.** Extra Large Table permitting the handling of large work with ease. **2.** Interchangeable Spindles for ¼" and ½" hole cutters for various types of work. **3.** Improved Completely Adjustable Fence for all varieties of straight work starting pin for curved work of all kinds. **4.** Complete Guarding system. **5.** High Speed of 10,000 R. P. M. which with standard 3-lip Delta cutter gives over 30,000 cuts a minute, thus insuring smooth and finished work. **6.** Complete range of cabinet and sash cutters for all types of mill work

For full details and description of this unusual tool together with illustrations of large variety of work that can be done with it send coupon for the new 1936 Delta Catalog.



You will be astonished at the advanced skillful design to be found in all Delta quality motor-driven tools.





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NEW LINE of ADVANCED GRINDERS

Not just another line of grinders but revolutionary new grinders in every sense of the word! Bench-drive, motor-driven and pedestal models — they all embody Delta's high standards of design and construction. No pains have been spared to make these new Delta Tools Ideal in every way—convenient, safe to use and efficient. Truly, here are the grinders that shopworkers have always wanted—and at the unusually moderate Delta price levels

WRITE FOR 1936 CATALOG

It is crowded with photographs and information about the new line of 1936 Delta tools. It contains much valuable information that every man interested in modern tools should have. It shows how Delta tools are built to stand the grind of production work and yet are so low priced as to be within the reach of all, how they save time, money and labor and quickly pay for themselves

Mail coupon without delay. Enclose only 10 cents at same time for Book No. 2 of Practical Delta Projects, 87 pages of new and novel things to make, with numerous blue prints, working drawings, photographs and illustrations and complete directions

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(Dept. 61235) Milwaukee, Wis.

The Delta line includes Circular Saws, Jointers, Lathes, Scroll Saws, Band Saws, Routers, Shapers, Grinders and a complete assortment of attachments and accessories.

Pedestal model motor driven Grinder with built-in switches, water pots, and combination tool tray and water pot holder.

New motor driven Bench Model Grinder

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Name

Address Age

City State

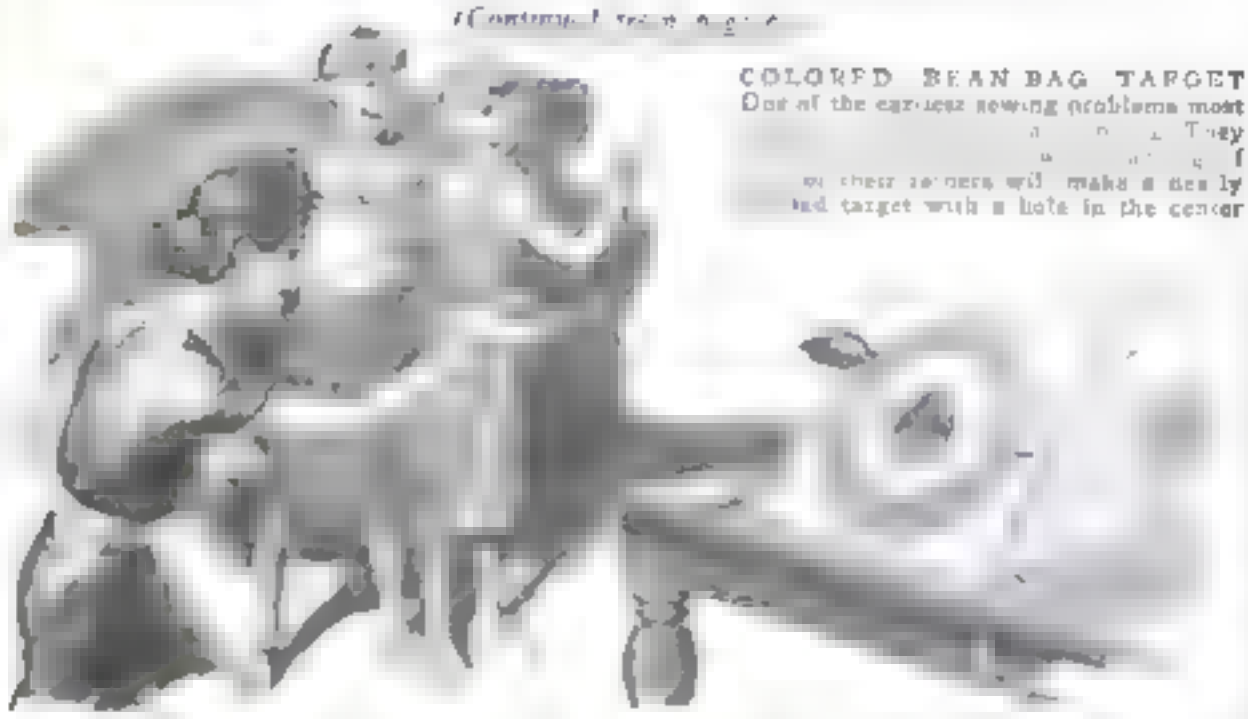
Check here if you are a Delta user now

The Delta QUALITY represents real ECONOMY

Snapshot of Vernon Palmer, Caribou, Maine

TEN GAMES, TOYS, AND NOVELTIES

(Continued from page 73)



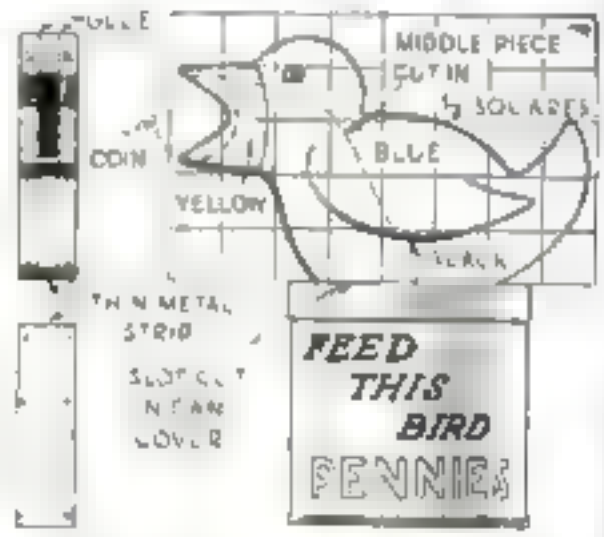
COLORED BEAN BAG TARGET
One of the easiest sewing problems most [illegible]. They [illegible] of [illegible] scraps will make a gaily [illegible] target with a hole in the center

number of times—fourteen in the case of the original model. Note that the wire is a single continuous length.

In the push-peg puzzle, the long pegs, which are painted black for [illegible] on at one end, are mixed up and pushed all the way into the holes from one side until the dark ends are flush with the block. The short pegs are then mixed up and pushed, one at a time, into the holes on the opposite side of the block as far as the cardboard caps will allow them to go. They will of course partly push out the longer blocks if they happen to do so in such a way that only the black portion of each block protrudes, the puzzle is solved.

The rocket race

WALL LANTERN
A Christmas ornament [illegible] on



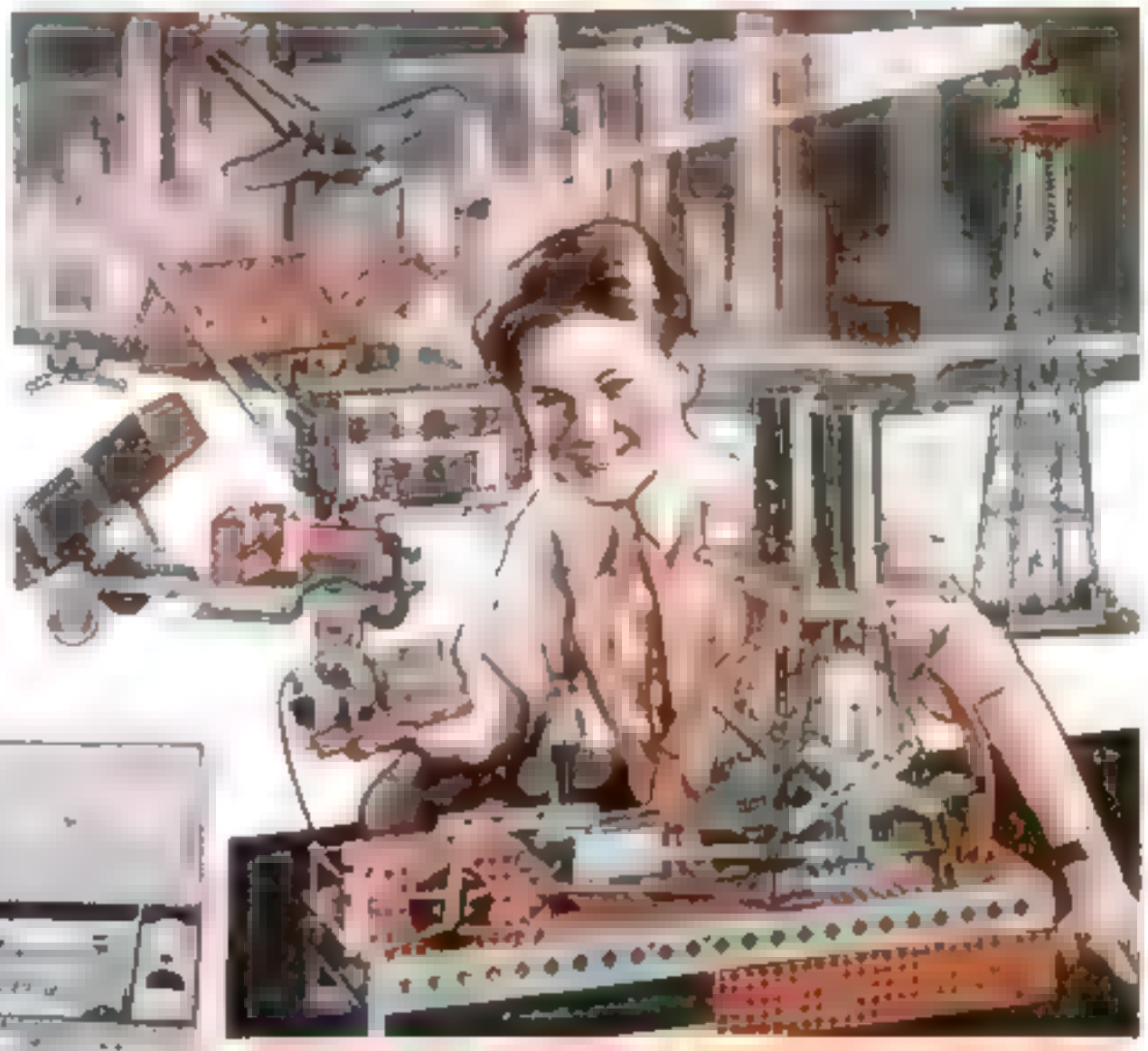
PENNY BANK SHAPED LIKE A BIRD
The bird is made from [illegible] pieces of wood, all [illegible] sawed at once. The center piece is about [illegible] in thick but the outer ones may be a little thicker. Cut the middle piece as shown by the dotted line, assemble the three and close the front of the slot with a strip of thin metal. Fasten the finished bird over a slot cut in the top of a tin can

POCKETS RACE TO MOON IN EXCITING GAME
The contestants take turns throwing three darts—or vacuum [illegible] if you object to darts. Move rocket up one if

SEE WHAT MIGHTY MECHANICAL MARVELS YOU CAN BUILD WITH

The Great New

ERECTOR



Hello Boys!

Look at that giant power plant! You build it yourself with the great new Erector. Piece by piece you erect its massive steel frame. Assemble its enormous fly wheel—pistons—governor. Mount its big, shining boilers. Then you hook up the powerful Erector electric engine and it throbs with action.

That's only one of the many exciting engineering models you can build with Erector. You can make that marvelous magnetic crane. Click the switch on the Erector Engine—pull the control levers and it raises or lowers—swings to the right or left, just as you command. Its magnet is so strong it grabs up steel girders before it touches them.

You can build *all* of the engineering models shown in the picture—and dozens more—with *one* Erector set. Enormous drawbridges that actually open and close. Towering airplane beacon that revolves just like the real ones. All-metal airplane. Dump-trucks. And—with the new Erector skyscraper set—you can build skyscrapers as tall as you are.

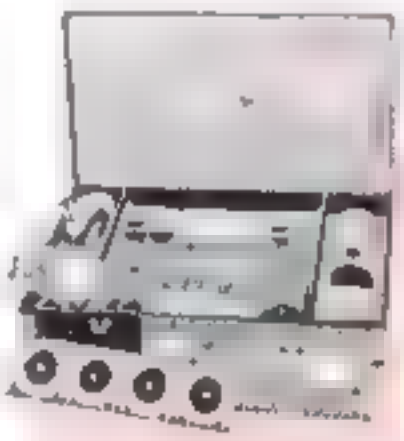
You're a full-fledged engineer when you have an Erector—ready to build realistic, engine-driven models of the world's greatest mechanical marvels. There are more wonders—more exciting hours of fun—packed in an Erector set than anything you can own.

A. C. Gilbert

Ferris Wheel

Built with the No. 7½ Set

Operated with the new Erector Electric Engine.



NEW COLORS MORE PARTS

Easier Model Building

The Great New Erector sets are the finest ever made

Look at this

SENSATIONAL No. 7½ SET

Contains the powerful new Erector Electric Engine. Gears and structural parts enameled green, yellow and blue. Glistening boiler parts. The new snap rivets, gears and other engineering parts for building ferris wheel, magnetic crane trucks, bridges and over 150 action models. With all these new features, only $10.95. Other sets from $1.00 to $25.00.

NEW The Erector Electric Engine. Not just a motor—but a real engine complete with built in gears.

NEW Skyscraper parts. Builds realistic models of Radio City and other famous skyscrapers.

NEW Big, solid steel base plates and giant girders—make possible larger and stronger models.

NEW Double feature Snap rivets for speedy building—nuts and bolts for sturdy building.

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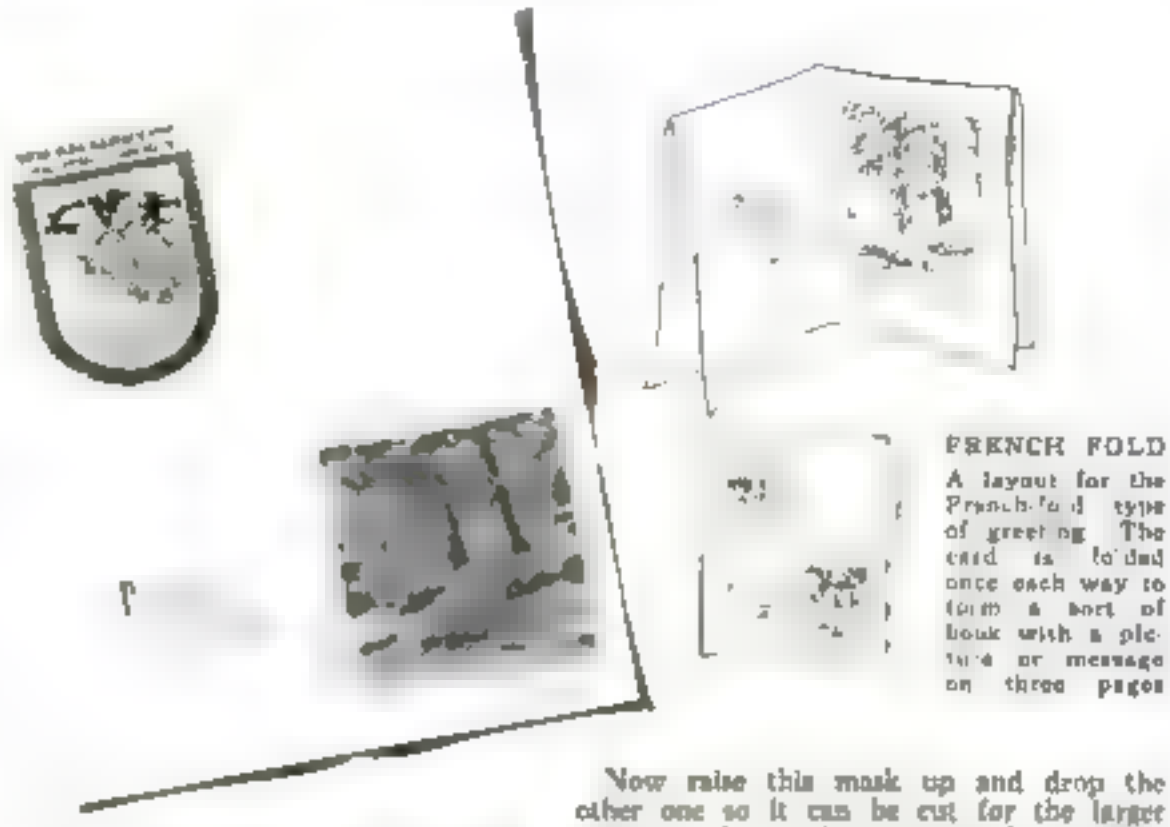
PHOTOGRAPHIC CHRISTMAS CARDS

(Continued from page 70)



FRENCH FOLD
A layout for the French-fold type of greeting. The card is folded once each way to form a sort of book with a picture or message on three pages

cards, lay out the card with pencil on the mask and carefully cut the openings for the view and greetings negatives. Fasten the negatives in place with bits of adhesive tape, and you are ready to print the cards. Make sure that the negatives are on the upper side of the mask as it lies in the printing frame so as to insure clean-cut printing. In fact, it is usually a good plan to place a thick piece of cloth or thin felt between the paper and the back of the printing frame to increase the resilient pressure against the negatives. The printing time should be adjusted to produce absolutely black letters.

The procedure for the French fold type of card is the same as for the simple card except that it requires three negatives and a larger size of printing paper. This greeting card is folded once each way so that a 4 by 5-in. card requires an 8 by 10-in. sheet of paper. However it is one of the most dignified of Christmas cards, and if the hinge is pierced with the point of a penknife and a red ribbon tied with a bow added, it makes a beautiful remembrance. After they are washed all cards, unless they are to remain flat, should be accurately folded and then dried flat between blotters. After this treatment they can again be folded for mailing without danger of cracking the emulsion at the fold.

Another effective card is made by the use of two negatives of somewhat similar subject matter one much larger than the other and both printed on the same card. Two masks are needed for this card, and their registration must be very accurate.

First cut the blank masks to the exact size of the opening in the printing frame and hinge them to the two opposite ends of the glass by means of adhesive-tape hinges. Raise one mask up out of the way and carefully cut the openings for the smaller view negative and the greeting negative. Save the oblong piece removed to accommodate the view negative, as you will need it.

Now raise this mask up and drop the other one so it can be cut for the larger negative. Place this negative in position. Again place the first mask next to the glass and place the cut-out piece that you have saved in the opening from which it was removed. Put a few dabs of library paste on this piece and then drop the second mask into place. Close the printing frame until the paste has dried, and the small piece will have fixed itself onto the large negative.

Now fasten the small negative and the greeting in place and print through this mask first. Swing the first mask out of the way and print through the second mask. The finished card will show the smaller picture accurately framed on the larger one and will cause much puzzling as to how it was accomplished.

A variation of this method is to replace the larger negative with a piece of writing or wrapping paper without a watermark. The finished card will then show the small negative on a mottled gray field. The so-called "butcher's paper" makes a pretty mask of this sort.

If you encounter (Continued on page 77)

This quickly made card is just a photo of a greeting lying on a desk

NOVEL PHOTOGRAPHIC CHRISTMAS CARDS

(Continued from page 76.

difficulty in registering the two negatives, scratch a line with the point of a needle stuck into a wooden handle around the outline or edge of the opening for the view negative. This will print a black line around the border of the smaller picture and will cover any slight unevenness. The black border, while it cannot be removed from the negative gives a finished touch.

Embossing your cards will give them a professional look that is well worth the extra effort. Cut a piece of thin cardboard to a size about ½ in. larger all the way around

Scratching a border line around the smaller negative used on a two-picture Christmas card

than the view on the card. Center the cardboard accurately over the picture, turn the whole thing over and trace the outline of the cardboard by using considerable pressure on the back of the greeting card. Use a smooth, blunt tool like the handle of a knife or spoon or a comb.

It is of course apparent that any of the cards described can be made by enlarging the view to its proper size through the mask of your own design. If you plan to emboss you will want to use one of the many bromide-chloride emulsions, as these papers are fast enough for almost any enlarger and at the same time they are slow enough to permit the greeting to be made by contact printing. The greeting cannot very well be made by enlargement.

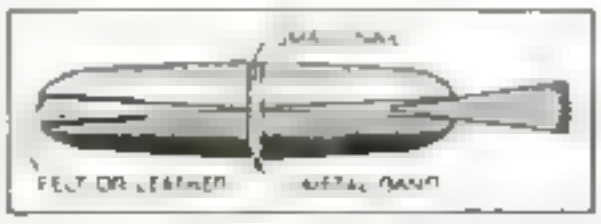
Embossing gives a card a professional look. A piece of thin cardboard is placed under the card and its outline traced with a blunt tool

HOLDER FOR SHOP DRAWINGS

THE spring of a mousetrap, removed from the wood base and screwed over the workbench, makes a good holder for plans and drawings.—O. B.

HAND VISE FOR HOLDING SMALL PARTS

SMALL objects such as jewelry or parts for models may be held conveniently in a homemade clamp or hand vise like that shown in the accompanying illustrations. This useful accessory can be turned on a lathe or shaped by hand. A good size is 1½ in. in diameter and 6 in. long, but this may be varied as desired. The band around the middle may be tin, brass, or any thin metal ½ in. wide and long enough to go around the clamp. The wedge is made the same general shape as the end of the clamp, but the size and thickness



will depend on the amount cut out. It is, of course, advisable to line one end of the clamp with felt or leather to protect the piece being worked upon from any danger of becoming scratched.—PAUL G. LACKEY

TESTED PLANS FOR CHRISTMAS GIFTS

TOYS, furniture, models, and other projects suitable for Christmas gifts are contained in the POPULAR SCIENCE MONTHLY series of blueprints. The following titles are only a few of those available. If you do not find what you want here, send a self-addressed, stamped envelope at once for our complete list.

New this month is a set of blueprints for a model of the clipper ship *Great Republic*.

TOYS

Acrobatic Monkeys, One-Legged Table and Hat and Coat Rack. *246A*	.25
Doll's House, Colonial. *77*	25
Doll's House Furniture. *71*	25
Projector for Photos and Pictures. *259A*	25
Six Simple Block Puzzles. *45*	25
Toy Airplane Cockpit with Controls. *114*	.25
Toy Birds and Animals, Jig-Sawed. *54*	.25
Toy Drill Press, Lathe, Saw, etc. *111*	.25
Toy Dump Truck, Fire Engine, etc. *101*	.25

MISCELLANEOUS

Hand Loom, Four-Treadle *246A 249A*	.25
Knitting Bag with Wooden Frame, Book Ends, and Cellar Holder. *247A*	.25
Microscope Kit, Portable. *120*	.25
Night Lamp and Sewing Kit *255A*	25
Perpetual Star Chart *214*	.25
Tie Rack, Extension Book Rack, and Turned Box. *247A*	.25

RADIO SETS

All-Wave Portable (battery) *217-R*	.50
Amateur Short Wave Receiver *155*	25
Amateur Radio Transmitter *182 184*	50
Five-Tube Short Wave A C or D C *223*	25
Full Electric Headphone Set *120*	25
One Tube (battery operated) *102*	.25
Screen Grid Set *109*	25
Short-Wave Converter Unit. *137*	.25

SHIP AND COACH MODELS

(Construction kits are available for some of these models. See page 8.)

Aircraft Carrier—U. S. S. *Saratoga* (18-in.) and flush deck destroyer (6½-in.), *226 227-R*	.75
Battleship—U. S. S. *Texas* (3-ft. hull), *197 198 199-200*	1.00
Bottle, Clipper Ship in *121 122*	50
Clipper Ship (20½-in. hull) *51 52-53-R*	1.00
Clipper Ship *Great Republic* (31½-in. hull) *273 273-274*	1.00
Constitution (21-in. hull) *57 58-59-R*	1.00
Cruiser *Brooklyn* (8-in.) *236*	25
Cruiser *Tuscaloosa* (11½-in.), *234*	25
Freighter, Ocean (14-in.), *271*	25
Galleon *Revenge* (25-in.) *204 207 208 209*	1.00
Hartford, Farragut's Flagship (31½-in. hull, special prints *221-222-R*	1.50
H. M. S. *Beauty* (8½-in. hull) *254*	25
Mayflower (17½-in. hull) *83-84-85-R*	1.00
Motor Boat, 29-in. Cruiser *63-64-R*	75
Motor Boat, Working Model (20-in.), *196*	25
Liner—*Aquitania* (9-in.), *225*	25
Liner—*Californian* (12½-in.), *251*	.25
Liner—*Normandie* (20½-in.) *284-285*	50
Liner—*Manhattan* (12-in. long) *204*	.25
Liner—*St. Louis* (11-in.) *231*	25
Privateer of 1812, *Swallow*, a Baltimore clipper (13-in. hull), *228-229-230-R*	1.00
Santa Maria (16-in. hull), *74-75-76-R*	1.00
Show Boat, Illuminated (14-in.), *241*	25
Stagecoach with horses *144-145 146-R*	1.00
Steamboat Mississippi (19½-in.) *94-95-96-R*	1.00
Steamships *Savannah* (3-in. over all) and *Atlantic* (6-in.) *251*	25
Trading Schooner (17½-in. hull) *232 233*	50
"Treasure Island" *Hispaniola* (7-in.) *237*	25
Viking Ship (20½-in.) *61-62-R*	75
Whaler—*Wanderer* (20½-in.) *151 to 154*	1.00
Yacht *Rainbow* (7½-in. hull) *253*	25
Yacht *Sea Scout* (42-in. racing) *106-107-R*	75
Yacht (20-in. racing) *48-R*	50

FURNITURE

Bookshelf and Book Ends, Modern, *100*	.25
Child's Costumer, *178A*	.25
Coffee Table with Spiral Legs, *265A*	.25
End Table, American Empire, *241A*	.25
Fireside Seats, wood and metal) *265A*	25
Floor Lamp with Tripod Base, *261A*	.25
Lamps, Modern (for turning) *31*	.25
Magazine Rack, Ladder-Back Style *250A*	.25
Mirror Frame, 20 by 30 in., *246A*	.25
Pipe Cabinet and Hanging Shelves, *77*	.25
Screens, Modern and Folding *81*	.25
Sewing Cabinets, Two *31*	25
Silverware Chest on Stand *256A*	25
Smoking Stand, Modern, *238A*	25
Stool, Upholstered, *240A*	.25
Table, Four Leaf Card, *239A*	.25
Tables, Tilt-Top, *249A*	25
Tavern Table and Scroll Mirror, *105*	.25

BOATS

*Duck Boat, Folding, *170-R*	50
High-Speed Boat for Small Outboard Motors (7 ft. 11 in. long), *257*	25
Installing Inboard Motors *270*	.25
*15-ft. Runabout or Sportboat (outboard or inboard motor) *175-176-177-R*	1.00
*13-ft. Utility Rowboat (can be used or used with outboard motor) *224-R*	50
*13-ft. Racing Runabout *261 262-R*	75

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra.

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Send me the blueprint, or blueprints, numbered as follows

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FOUR PIECE FIRE SET HAMMERED OUT COLD

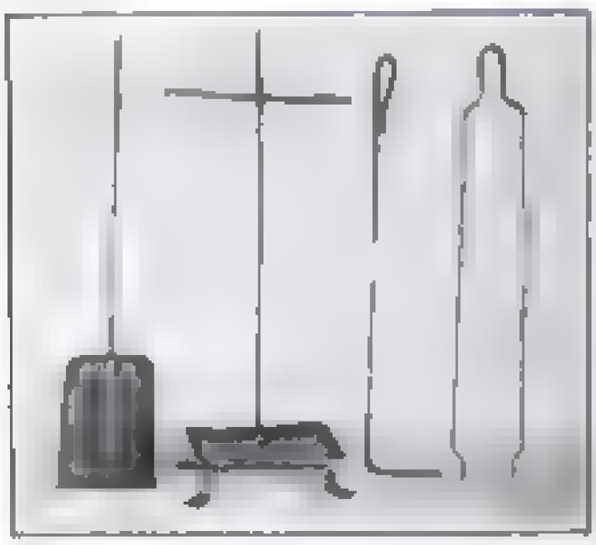
THIS decorative fire set can be made without a forge in any home workshop. The stock required is 12 ft. of 3/8-in. square iron, 16 in. of 1/8 by 1-in. iron, and two pieces of 1/16-in. thick sheet iron, one 5 by 7 in. and the other 6 1/2 by 8 in.

Round the corners of the 5 by 7 in. piece, and use a ball-peen hammer to hammer around three sides. Hammer on the inside and cup the piece slightly into the shape of a shovel. Then hammer the front edge down sharp. Cut 23 in. of the 3/8-in. stock, hammer it all over, place in the vise, and twist about 2 in. in the center, as shown. Shape the handle and the other end, drill holes, and fasten the piece to the blade with iron rivets.

The tongs requires 47 in. of the 3/8-in. stock. Flatten and shape both ends, bend evenly in the center, and shape the handle. Then add the twists.

The poker is made from a 30-in. length of stock. Of this 4 in. are bent up and hammered into shape to form the poker end. The handle is the same as that on the shovel.

The rack is hammered into shape like the shovel. The column (Continued on page 80)

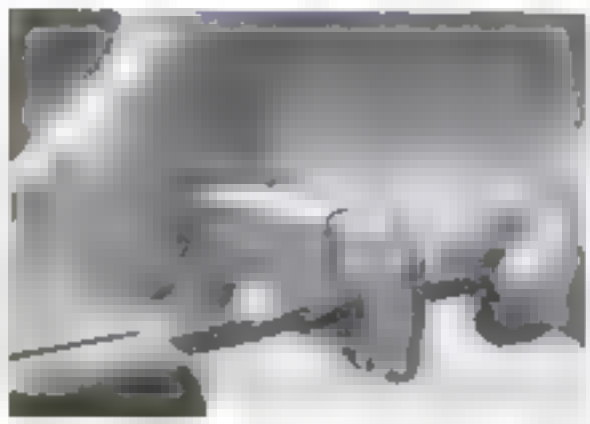


The fire set consists of a shovel, poker, and tongs with a suitable stand (second from left)

The inside of the shovel is hammered with a ball-peen hammer into a shallow cup shape

FOUR-PIECE FIRE SET

(Continued from page 79)

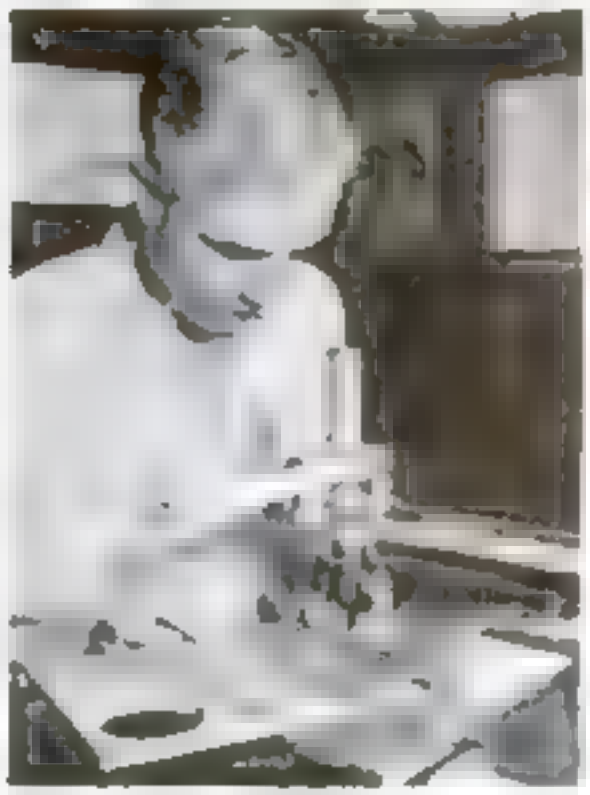


The decorative twists are made by holding the stock in a vise and using a monkey wrench

is 35 in. long and made like the shovel handle The ring is bent from a piece 10 in. long and riveted to the column. The legs are ⅛ by 1 by 4 in., bent to shape and riveted in place

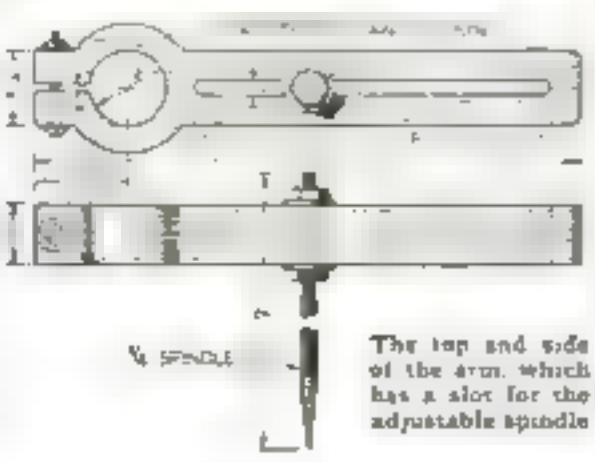
Coat each piece with machine oil and heat until black to give a finish resembling forged work DICK HUTCHINSON

JIG FOR CUTTING DISKS ON A SCROLL SAW



An adjustable spindle which projects down from the overarm, serves as a center about which the stock is turned during the sawing

WITH the aid of the simple jig illustrated disks may be cut on a modern scroll saw that will be almost perfect circles It was designed by Lowell R Browne of Monrovia, Calif. The arm should be made of hardwood unless you have facilities for casting aluminum or have access to the manual training shops of a community school. In that case an aluminum casting will make a more rigid piece for the bracket.—H. S.



The top and side of the arm, which has a slot for the adjustable spindle

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A few copies of the 1934 Index are still available. If you want one, inclose twenty cents and both the 1934 and 1935 issues will be sent.

OLD TOWEL BOX SERVES AS SECRET WALL SAFE

FROM a discarded 18-gauge steel towel box approximately 14 by 7 by 6 in., with a fairly good lock and keys, I made a small wall safe. Since the bottom was slotted, I hammered it out flat and lapped the slot sides, making a neat joint. The inside was lined with thin asbestos board, which was glued in place. The box was finished with two coats of a dark shade of lacquer.

In a remote closet I cut through the plaster and made a recess large enough to take the box, which I screwed firmly to the studding at one end and a filler block at the other end. To conceal the box further, I glued a piece of wall paper of the same texture and color as the wall on the outside of the box cover, which was set in an upright position to open out flat. Only the small round keyhole is visible, and no intruder would be likely to discover it.—J. M. MURPHY

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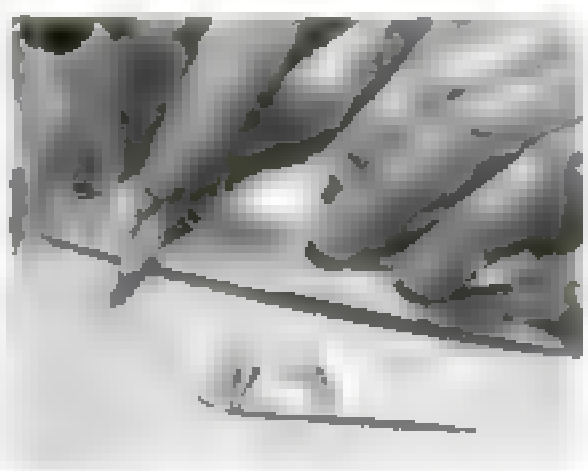
GENUINE METAL FINISH FOR MODEL AIRPLANES

METAL obtained from empty tooth-paste and shaving-cream tubes may be used to obtain a realistic all-metal finish on solid model airplanes. As the tubes are emptied, they should be squeezed flat rather than rolled up in the ordinary manner. Remove the metal binding and cap shoulder, then slit one side and press the piece out flat. After cleaning off the surplus paste, remove the printing from the outside with a bit of cotton and acetone or lacquer thinner. You can then take out all wrinkles and make the piece perfectly smooth by rolling it with a smooth pencil.

This thick foil is very easy to apply to any surface, flat or irregular. After cutting a piece to size with scissors, coat it with cellulose-type cement (or celluloid scraps dissolved in acetone to make a very thick syrup) and immediately press it into contact with the wood. Remove any surplus cement by rolling with a pencil or pressing with a burnisher. The foil can be pressed into any indentations with the smooth head of a match. Laps should be burnished with a pencil.

After the model is covered as far as desired, allow the cement several hours for drying and then go over all the foil surfaces with fine steel wool. This will impart a brilliant satin finish. Small details that are to appear especially bright can then be burnished by rubbing with a smooth, rounded metal tool such as the bowl of a small spoon.

If any parts are to be colored or striped, best results are obtained by using clear lacquer to which transparent coloring pigment has been added.—KENNETH MURRAY.



Applying foil to the wing of a model plane. The lap is burnished smoothly with a pencil

A dull pencil, pressed heavily to leave an indentation, is used to mark aileron hinges

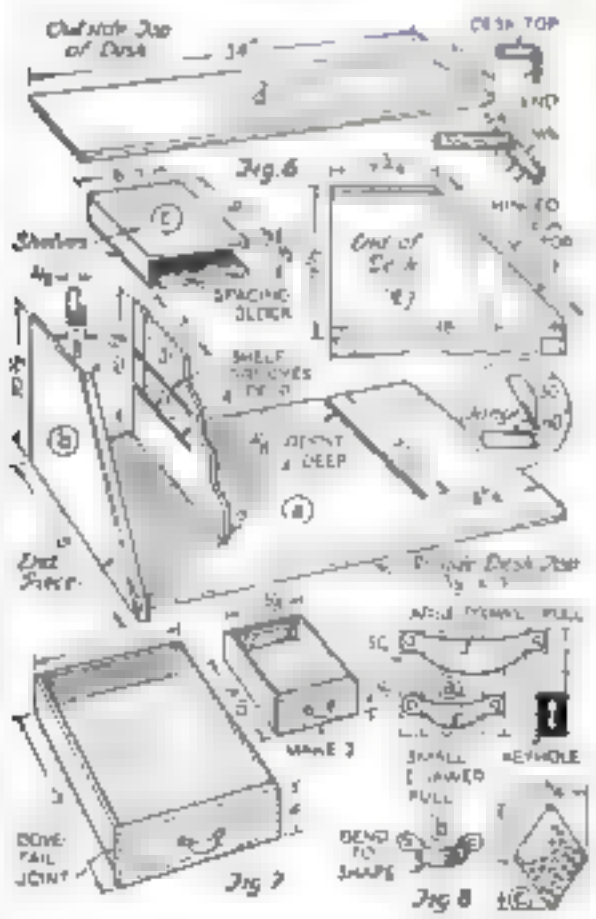
SLANT-TOP WALNUT DESK

(Continued from page 66)

The desk with the top and gate legs closed

entirely across the desk, space being left for the gate-leg recess and a drawer. A piece of 1 by 4-in. material fitted to the front cross members at right angles as shown at b, Fig. 3, provides support for the drawer runners and the cross members. A ¾ by ¾-in. strip glued to the bottom edge of the back cross member supports the back ends of the drawer runners. The drawer runners are fitted at the front ends by lap joints. Recesses are cut as shown for the swinging gate legs.

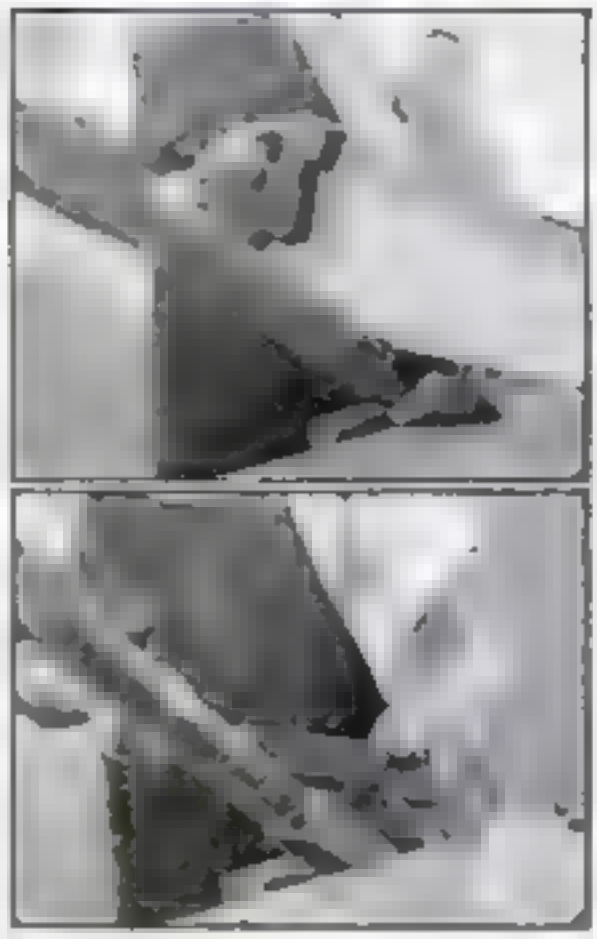
Dimensions for the front and end rails are shown in Fig. 4. These are made of ¾-in. walnut. Holes ¾ in. in diameter are bored in the ends for fitting on the legs. The top front rails are left square cornered to fit flush with the front of the desk, but the lower rails are much more attractive if the edges are rounded with a shaper or worked off across the edge with a file or strips of sandpaper. A triangular recess ¼-in. deep (Continued on page 84)



The construction of the upper part of the desk, including drawers and special fittings

SLANT-TOP WALNUT DESK

(Continued from page 83)



The upper view shows the process of sawing the special lines ¼ in. deep; the other photo, the first step in reaping out the grooves

to cut in the top of the upper rail at a, Fig. 3 for fitting the end of the gate-leg stop, which is shown at c, Fig. 5.

Before assembling the rails and the legs, go at the two bearings on the outside iron legs, both inside the rail bearing and on the leg dowel, with hot paraffin. Glue the joints marked d, Fig. 3, right, but leave about 1/32-in. space at e so the bearings will not bind. Use a good grade of glue.

Figure 5 shows a ¼-in. strap iron bent over at the end and a keeper for limiting the swing of the gate-leg front. Mount these as at c, Fig. 1.

The desk top is shown in Fig. 6. It was cut from a glued-up piece of walnut to the dimensions shown at a. A 60-deg. bevel was cut on the front edge. (Continued on page 85)

The finishing is done with narrow strips of tough-backed sandpaper, followed by a rubbing with fine sandpaper as shown in the circle

SLANT-TOP WALNUT DESK

(Continued from page 84)

and two 12½-in. long grooves were cut for the lower edge of the dividing walls of the desk. The ends of the desk were built of ¾-in. veneered stock as shown at *b*. A ⅝-in. strip was rabbeted and glued to the front edge to give added strength. However, this entire piece may be made of ⅝-in. material, if desired. In that case it will be unnecessary to use the spacing block shown at *c* to set the drawer over to miss the edging strip. Shelves and inside dividing walls were made of ⅜-in. wood as shown at *c*, and the outside top of the desk is given at *d*. The cross sections and view at *e* show in detail the fitting of the top and the desk board

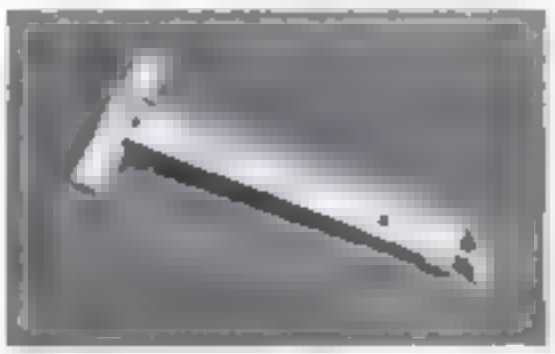
Figure 7 illustrates the construction of the drawers. The larger drawer was made with dovetail joints, and the two smaller inside drawers with simple rabbeted joints

Hand-hammered lacquered copper hardware was used Dimensions for the drawer pulls are shown at *a*, Fig. 8. These blanks were cut from heavy copper and hammered to the shape shown at *b*. Two diamond-shaped bumpers were cut and hammered from copper as at *c*. These were nailed to the desk board with copper nails so they rest on the top of the two gate legs when the desk is open and prevent marring the desk board.

ANGLE-IRON FENCE FOR RIPPING ON BAND SAW

Home workshop owners who have a hand saw but no circular saw often find it necessary to rip long, straight pieces of stock on the band saw. A simple ripping fence for this purpose, if the band saw has none, can be constructed from angle iron, such as a piece of an old bed-spring frame.

A short piece about 4 in. long is riveted at right angles to the end of the long piece, as shown This serves as a back support to insure that the fence will always be parallel to the saw blade when it is clamped in position. At the other end of the fence, fasten a small piece of metal which has been threaded for a thumb screw. The distance between the inside surface of the back support and inside surface of the thumb screw mounting should be approximately ⅜ in. greater than the width across the band-saw table.—J. L. Bird.



Ripping fence for a band saw made almost entirely from piece of an old bed-spring frame

GASOLINE CLEANS SHOE BRUSH

When the family shoe brush is so full of wax polish that it will no longer shine shoes, it may be cleaned by soaking it in gasoline and then washing it with the garden hose. The finer the hose stream and the greater the pressure, the better the results.—M. A. Conrin.

HOME WORKSHOP CLUBS

Rush Work on Toys for Needy Children

OUT to break their remarkable record of last year, home workshop clubs throughout the country are hard at work on toys to be distributed to the needy children of their communities at Christmas. There are now 161 active clubs, and the combined output of toys will be impressive. Last year there were single clubs, such as that in Denver, Colo., which constructed from 500 to 800 new toys, and even relatively small clubs in many cases distributed as many as fifty well-painted handmade playthings.

Some of the clubs made their plans months ago and gathered a large stock of materials through donations from dealers, the salvaging of lumber from old boxes and the personal contribution of waste stock by members.

The best way for a club to make a large number of toys, it has been found, is to study the combined shop facilities of the members and then pick two or three fairly simple but novel and attractive toys that can be made to best advantage on the machines available. Samples of possible toys are brought in by various members and fully discussed with a view to improving the design, if possible, and simplifying the manufacturing operations. The stock is then marked by means of templates, and the parts are made as far as practical on a production basis. It is often possible to speed up the work by making simple jigs and fixtures. A striking example of this method of attacking the problem was given in a previous issue (P. S. M., May '33, p. 91.)

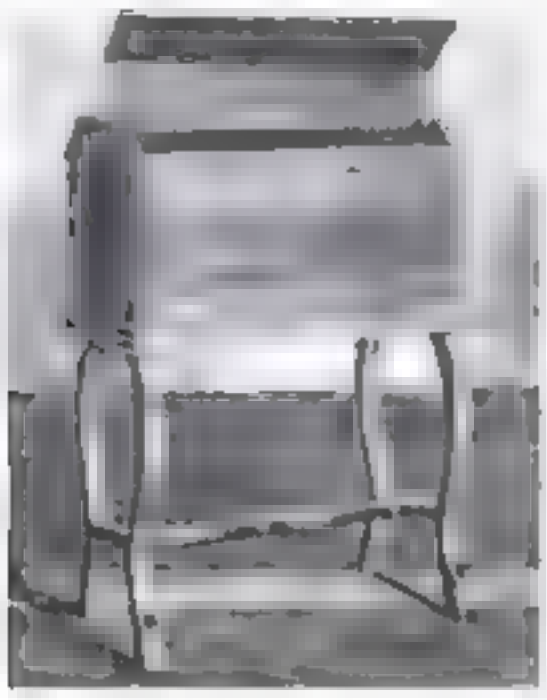
As far as possible, of course, the parts are painted before assembly, but what painting remains is divided up among the members best equipped to undertake it. Few clubs are without at least one member who has good paint-spraying facilities. If it happens there is nothing of the sort available, it would pay the club to consider purchasing a complete outfit or assembling it as a club project.

Designing and constructing a good portable paint-spraying outfit would, indeed, arouse as much interest in the average club as any project. An example of what can be done is shown in two of the accompanying illustrations. This, however, was not made by a club, but by LeVern T. Ryder, president of the National Homeworkshop Guild.

(Continued on page 88)

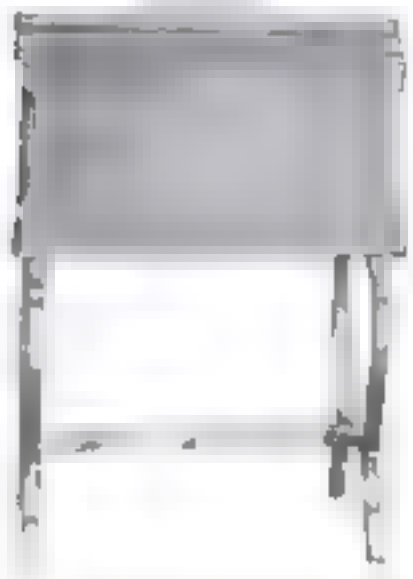
A window exhibition of outstanding craftwork by members of the Washington, D. C., club

SEWING-MACHINE COVER SERVES AS CABINET



OLD-FASHIONED sewing-machine covers, which are still to be found stored away in many attics, can easily be converted into useful and attractive sewing cabinets. The one illustrated was made from a walnut cover by adding legs to make it 25½ in. high, exclusive of the handle. The top was cut in two parts to make the lids, and a 1½-in. piece was fastened across from end to end so that the lids and handle could be attached to it. A tray 1½ in. deep and half the size of the cabinet was made to slide on ⅝ by ¾-in. strips glued to the sides.

The legs and stretchers were cut from ¾-in. stock and assembled with dowels. The top of the legs, which were left straight for 1 in., were set into the box and fastened with glue and screws. Of course, the legs could be turned or designed in any way preferred. The handle was cut from 9/16-in. walnut and fastened to the 1½-in. piece with screws from underneath.—F. U. Jeppo.



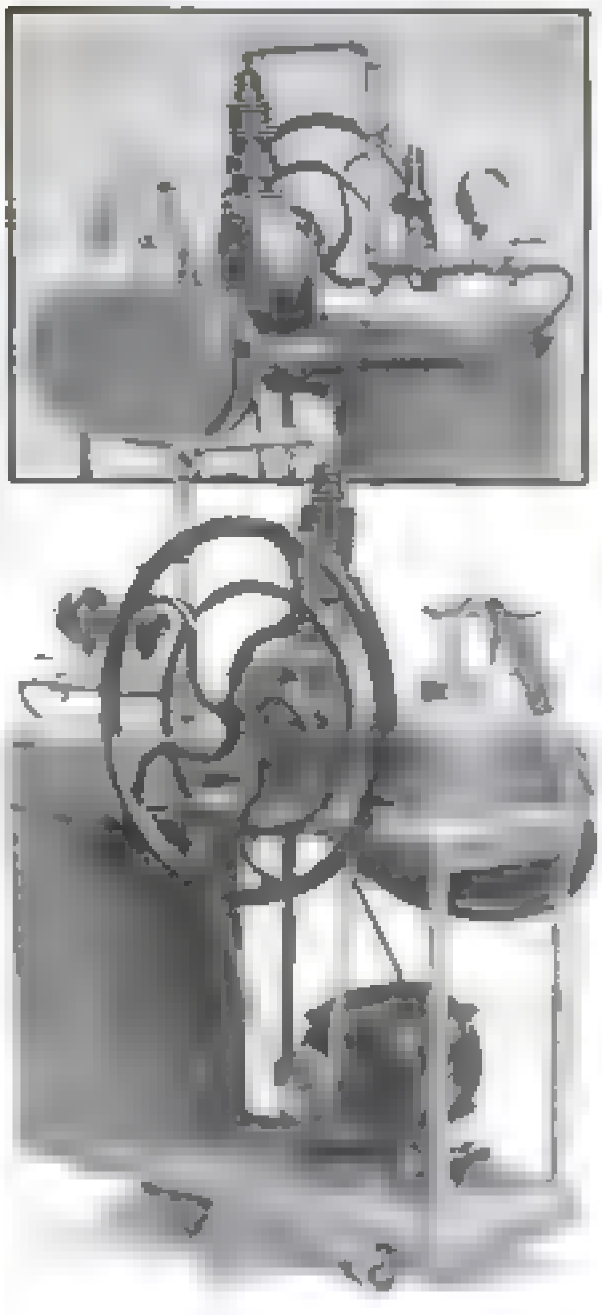
The box part of this walnut sewing cabinet is the cover from a discarded sewing machine

NEAT SHIP-MODEL PORTHOLES

WHILE working on a model of the destroyer *Preston*, I met the problem of making the portholes by sharpening one end of a piece of 5/32-in. brass tubing and forcing it like a hollow punch into the hull. I then lifted out the excess wood with a knife point and pushed the end of a piece of ⅛-in. brass rod into the hole to press down any loose fibers of wood. When the hull was painted, disks of black paper were punched with the sharpened end of the 5/32-in. tubing and cemented into the holes.—HAROLD HART KNOLL.

HOME WORKSHOP CLUBS

(Continued from page 56)



Two views of a portable paint-spraying outfit assembled by the president of the Guild

for his personal use. The air tank is scrap from a small water system, the compressor is a tire pump from an old-style auto. The fly wheel was taken from an old sewing machine. The pump bracket is made of angle iron. The air gauge, relief valve, and fittings are new material. A 1/4 h.p. washing-machine motor drives the compressor. The spray gun and hose are standard. Note the 3/8-in. pipe running from the compressor to the tank; it is important to use this instead of the 1/8-in. size with which old tire pumps are fitted. With the smaller pipe the pump will run hard and the pipe will heat badly.

CLUB ACTIVITIES

Waite Homeworkshop Club, Worcester, Mass. At the organization meeting of this new club, the following officers were elected: L. Harold McKinsty, president; Joseph H. Smith, secretary; Burton D. Stone, treasurer.

Capital Hometcraft Club, Washington, D. C. The first public exhibition of members' work was held for two weeks in the show windows of the Canadian Pacific Railway offices. The printed program, besides listing the exhibitors and officers of the club, contained a coupon addressed to the secretary of the club, as follows: "I would like to know more about the Capital Hometcraft Club and to meet its members. I would be pleased also if you would send me an invitation to attend the club's next meeting." This was provided so that any visitors who wished to do so might leave their names and addresses for further information about the club. One entire page of the program was given over to (Continued on page 98)

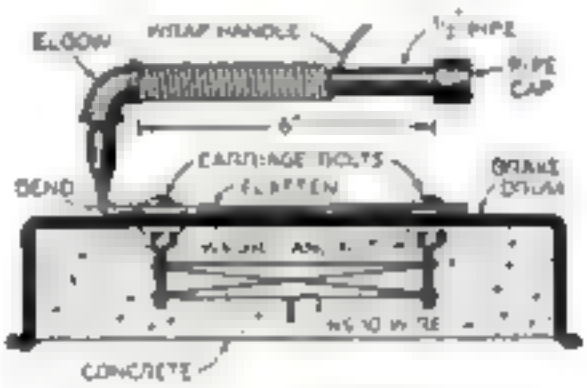
CURLING "STONES" FROM BRAKE DRUMS

THE ancient game of ice curling is rapidly gaining popularity as a winter sport. The principal expense is for the so-called "stones," but this can be reduced to a nominal sum by making them from old auto brake drums.

The game may be played on any reasonably large expanse of smooth ice. The rules and regulation layout for a curling rink can be found in athletic handbooks. Curling can be practiced, however, simply by laying out a circle 100 ft. in diameter with a ring 4 ft. in diameter in the center. A piece of heavy cord and two spikes will serve as a compass. The object of the game is to stand outside the large circle and slide the heavy stones along the ice in an attempt to place them inside the 4-ft. circle.

Old auto brake drums may be obtained at any junk yard. Select four or six of similar pattern. Those having a rolled edge are to be preferred. A piece of ½-in. pipe, 10 in. long, with threads on one end, is hammered flat to within 2½-in. of the threaded end and bent at a right angle, as shown in the drawing. Then drill the flattened section to correspond with two holes in the brake drum. Fasten this to the drum with carriage bolts longer than necessary and secure the nuts with lock washers. A piece of ½-in. pipe, about 6 in. long and threaded on each end, forms the handle. On one end of this screw a ½-in. pipe cap and on the outer end, a ½-in. elbow. Now tighten this assembly into the bent piece.

A "stone" made in this way will weigh from 5 to 10 lb. depending upon the drum used. If you prefer a heavier stone, connect the bolts extending inside the drum with a loop of wire, about No. 10 gauge, and pour full of concrete. The wire will hold the concrete in place. Smooth the concrete off with the top where it comes through the holes in the drum.



Sectional view of concrete-filled brake drum with handle made of ½ in. pipe and fittings

To give a good grip, the handle is wrapped with cord between the elbow and the end cap

Using heavy cord or light rope, wrap the handle between the elbow and the cap, and secure the ends by looping back under the wrapping. Shellac the wrapped handle and paint half of the stones you make red and the other half black.

Each contestant throws two or three stones, and the score is counted before the opponent throws. If the stone stops inside the small circle, it counts five points. One touching or stopping on the line counts one point. The first contestant to obtain 100 points is the winner.—V. B. JACKSON.

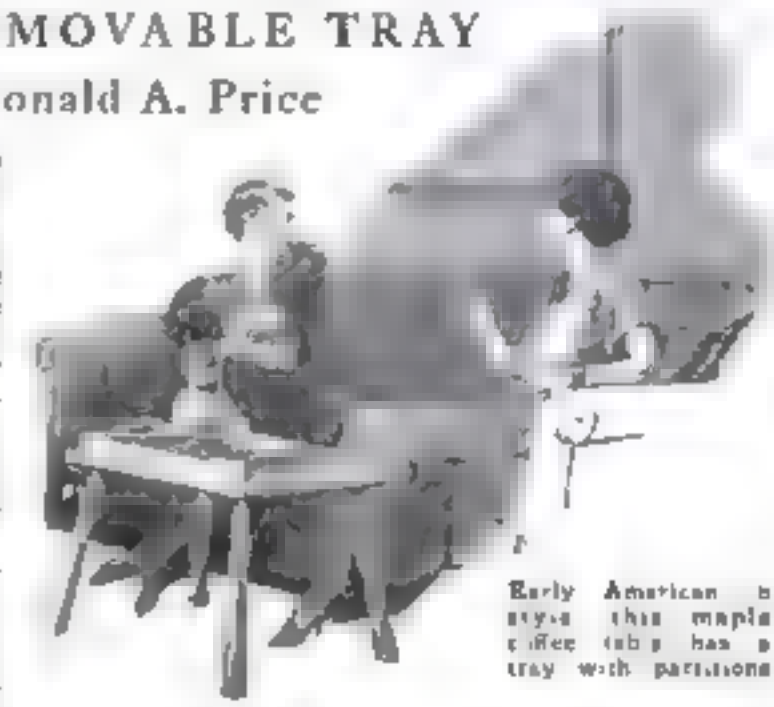
COFFEE TABLE

A COBBLER'S BENCH DESIGN WITH REMOVABLE TRAY

By Donald A. Price

THE typical cobbler's bench partitions on this coffee table are not fastened directly to the bench top as usual, but form the sides of a removable serving tray. When set on the bench, the tray is kept in position by pegs which fit in holes in the bench top near each corner. With the tray in place, the piece would also serve as a convenient and unusually decorative smoking stand, when the tray is removed, a sturdy bench remains.

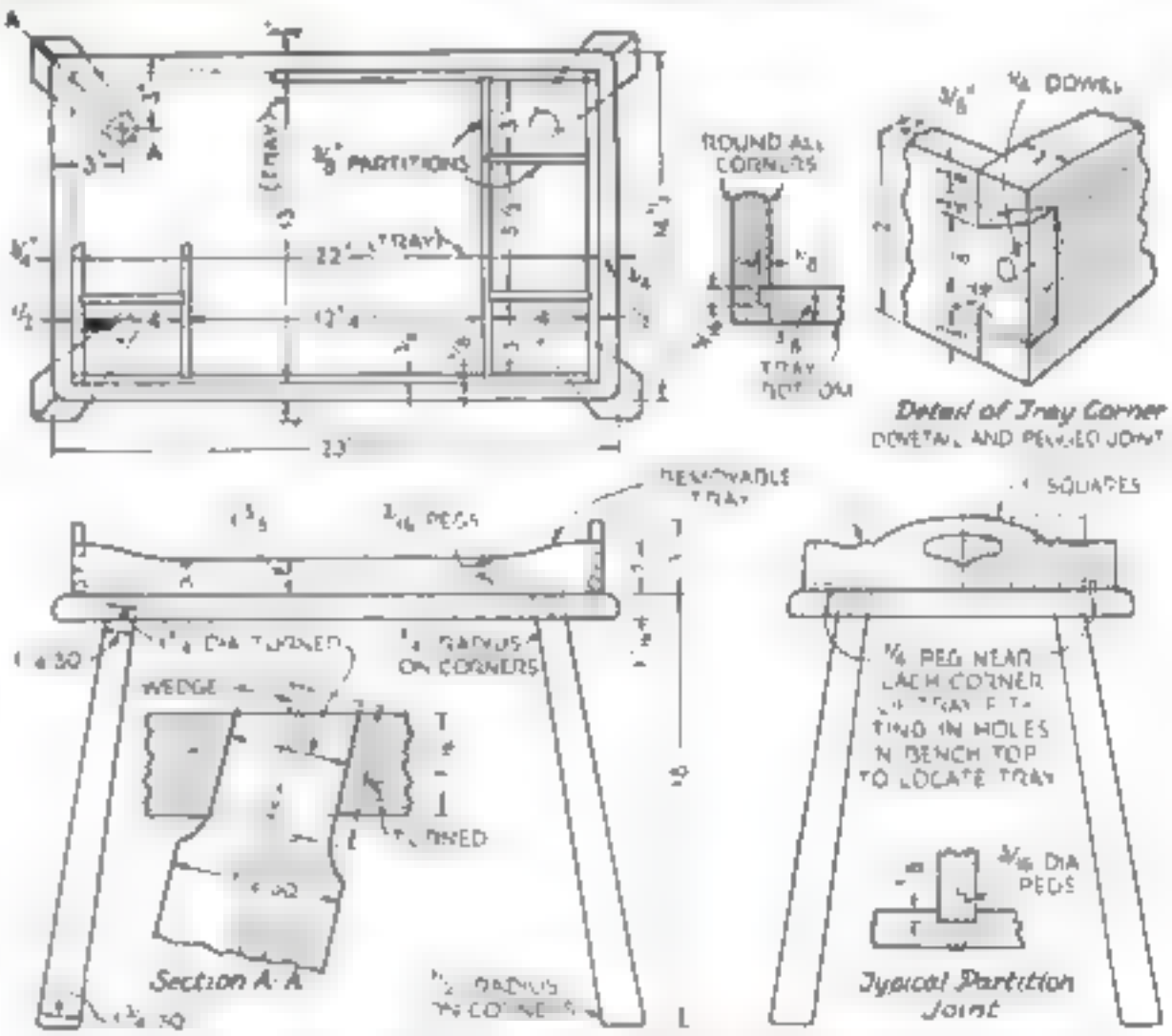
The square, tapered legs are turned at the upper ends, which pass through the seat or top. The angle given on the drawings for boring these holes, it should be noted, is taken on line A-A, which is at 45 deg. to the edges of the seat. Bore all the holes with a jig in order to get the legs at exactly the same slant. Use sandpaper wrapped around a 1¼-in. diameter rod to shape each hole slightly elliptical at the top in the direction the wedge tends to spread the wood.



Early American in style, this maple coffee table has a tray with partitions

Round all corners and sharp edges, taking the most off wherever wear would be expected to have occurred over a period of years.

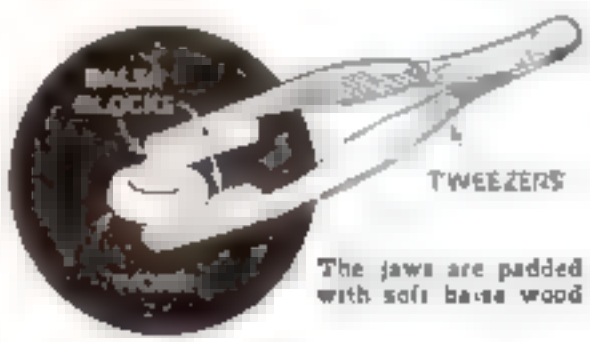
The design calls for the use of maple. Finish to match any other Early American furniture you may have.



Working drawings of the table. Note the pegs that keep the tray in place on the bench top

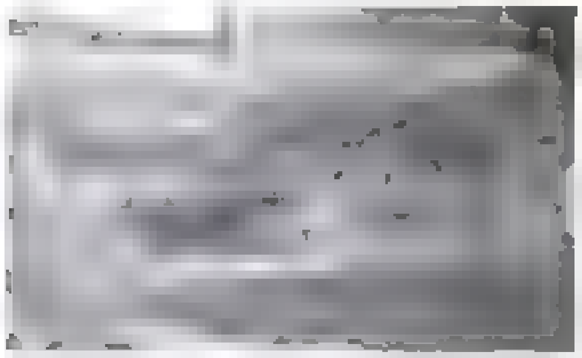
SOFT-JAWED TWEEZERS

WHILE making small blocks from balsa wood for the lifeboat tackle of the POPULAR SCIENCE MONTHLY destroyer model *Preston*, I hit upon the idea of gluing two pieces of very soft balsa inside the jaws of a pair of five-and-ten-cent-store tweezers. With this tool, small balsa parts may be held firmly without being pressed out of shape or otherwise marred.—HAROLD HART KROLL.



The jaws are padded with soft balsa wood

MODEL RAILWAY SCENERY BUILT UP WITH PAPER



Realistic scenery of cardboard and crumpled newspapers applied over a wooden framework

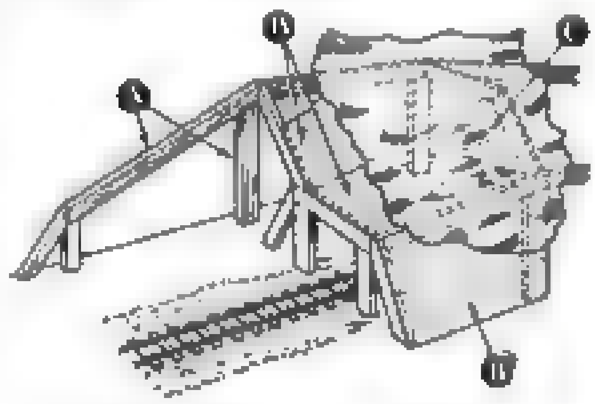
REALISTIC mountains, cuts, hillsides, and other scenic settings for a model railway may be cheaply and easily constructed by applying cardboard and crumpled newspapers to a rough frame of wood.

To build a tunnel, for example, first erect a wooden frame, either fastened permanently in place or made removable for access to the track within the tunnel. This should be of the general outline and size desired, as at *A* in the sketch below. Next, cover this frame with cardboard, tacked on as shown at *B*. Pieces of discarded boxes, old cartons, or anything will do because this will all be covered.

Mix up a good supply of wall-paper paste or ordinary flour-and-water paste. Clear off the top of the workbench or an old table, and have a pile of old newspapers at hand.

Open out a newspaper on the table and cover it with paste. On this lay another sheet of newspaper and coat it with paste. Continue in this way until you have four thicknesses of paper, the top of the last sheet being also covered with paste. Take these papers, which by now will be quite soft, and apply them to the hill with the paste side down. Crumble them up here and pat them down there till the desired shape is attained, as at *C*.

When dry, in about two days, paint in grays and browns, with a little green in places, and you will have a hill that will surprise you with its strength, lightness and excellent appearance. There will be none of the mess and unsightly cracking that accompanies the usual method of building scenery with plaster. An appropriate scenic background may be painted to match as shown in the photo above.—GEORGE G. KINNEAR.



The frame is first covered roughly with old cardboard, then with paste-soaked newspapers

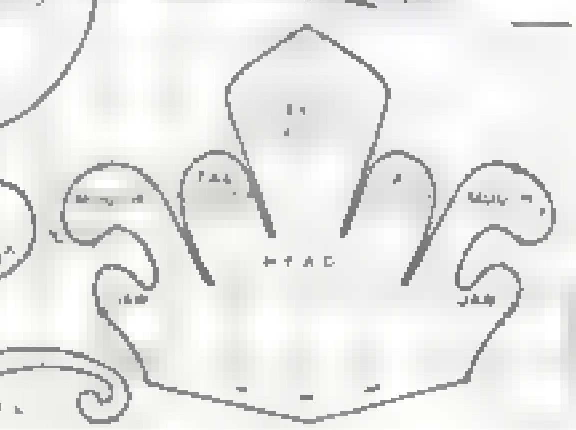
NEXT MONTH

A Model of the Yacht *Nourmahal*

A BEAUTIFUL little scale model of Vincent Astor's yacht *Nourmahal*, which has often flown the President's flag, will be the next in our Model-of-the-Month Club series. The plans will appear in the January issue.

FUN WITH COMICAL ANIMAL PUPPETS

(Continued from page 67)



This king of beasts will get a laugh anywhere. He is made from an old red inner tube with fur for hair. The patterns are cut as shown in the drawings. Bits of thin white rubber are sewn in the jaws for teeth, and a scrap of curled red rubber added to represent the tongue

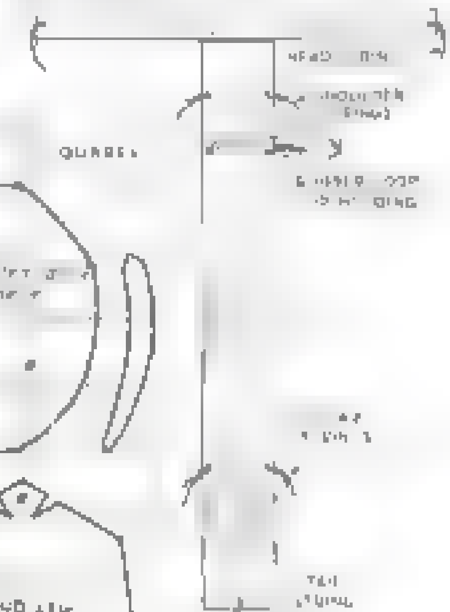
tangle. A drop of shellac put on every knot with a toothpick or other pointed tool will insure the knots' holding.

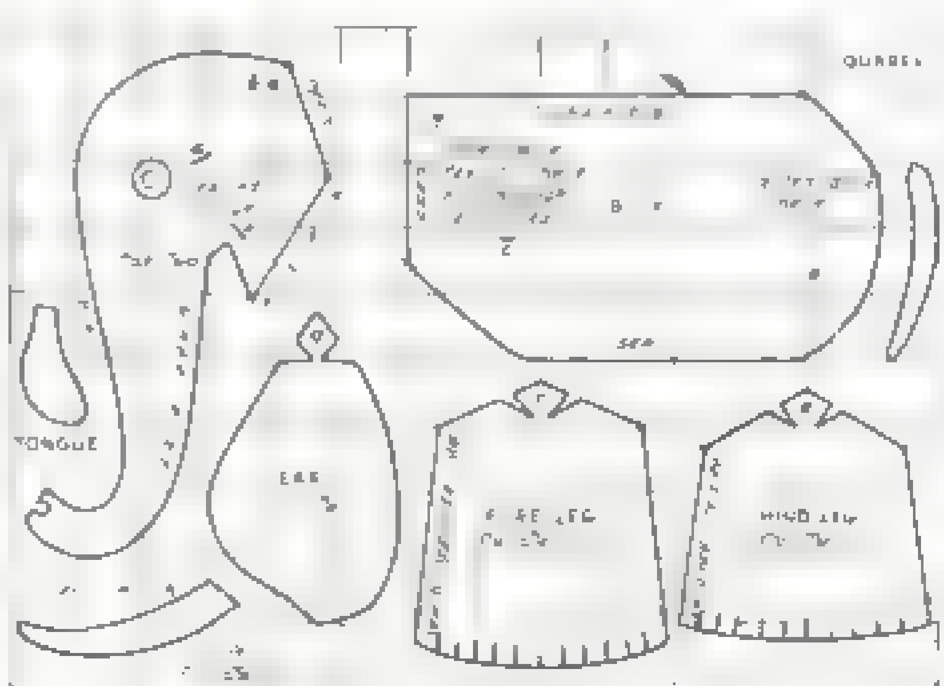
The seats should be nailed through the tail (where the lead is) to a board or to the floor of the stage, preferably about 10 in. apart, otherwise they will bob about when the ball is worked. They can also be fixed to two cones from which the tops have been cut. If these are weighted with sand or stones, they will hold their places. You have seen similar stands at the circus. Painted in gay colors, they will enliven the act.

Of course, the manipulation must be practiced by the operator before he attempts to give a performance before an audience. Slow smooth movements should be striven for. Pauses are effective and give contrast.

The lion requires a three-piece body, head, tail, two-piece forelegs, and one-piece hind legs. Arrowheads are cut where indicated on the drawings and slipped into slits. The head is attached by three strips ½ by 1 in. with arrowheads at each end. One end is slipped through a slit in the body, the other end through a slit in the neck. The body should first be sewed where indicated, then the legs inserted in slits cut in the body, and the tail joined in the same manner. Before attaching head to body, sew the nose and two jaw pieces together, tack back the ears and the eye triangles, and sew or glue hair where it is to go. Stuff the body loosely and slip spools in both the head and the body. With

How to make a standard controller for an animal





The elephant is cut from a dark gray inner tube with the rough side outward

The acrobatic tomcat all ready to perform

a large needle, pass a 50-in. length of carpet thread through rubber and spool for fastening to the controller

The controller for the lion or any four-footed animal may consist of a main stick about 1½ in. wide and the length of animal, and a crosspiece 8 or 10 in. long. The cross stick is fastened about 1 in. from one end of the main stick. Drill two holes in the front corners of the main stick, two more at the edges, about 2½ in. back, and two others 3½ in. from the front end. The latter are to hold the rubber thong beneath which the hand is slipped when manipulating the puppet and by which the puppet is hung when not in use. Drill another hole in the middle back end, and two more 2½ in. from this end. Attach the strings as shown

These sizes and spaces of course are approximate. The size and shape of the animal determines the spacing of holes and strings. No two figures are exactly the same. Balance and flexibility are very important.

A study of the illustrations will show how the elephant and other animals are assembled. One example of wooden construction—a frog—is also given for those who wish to attempt that more difficult type of animal puppet.

In following articles Mrs. Drake will tell how to make heads and bodies for marionettes of standard types with which complete shows may be given

Cardboard cylinders stiffen the body and legs

Old Bill SAYS:

WHEN grinding a milling cutter, remember that a cup wheel gives a flatter clearance and a stronger cutting edge than a dish wheel, which produces a concave clearance.

* * *

To avoid large burrs and unnecessary breakage of material when drilling aluminum and plastics, drill a pilot hole first and counterbore halfway through from each side.

* * *

Solder will adhere more readily to steel parts if they are given a coat of blue vitriol (copper sulphate dissolved in water).

* * *

A set of French curves is a useful addition to the machinist's tool kit. They are handy for blending curves on a layout.

* * *

To obtain a good finish when milling deep slots in steel or stringy metal, remove the clearance from sides of cutter.

* * *

Lathe and grinding centers that are tipped with tungsten-carbide will last a great many times longer than those made of even the highest quality tool steel.

* * *

More metal can be removed by using the down-feed than the cross-feed of a surface grinder, and the wheel will stand up longer.

SPECIAL HAMMERS FOR DECORATING METAL

THE surface of wrought iron, band iron, and heavy sheet steel is easily enriched by a method that may be called "texture hammering." The hammer has small grooves cut in the face; these leave a pattern on the metal. After being hammered, the metal is rubbed with emery cloth.

Before the hammer face can be cut, the head must be annealed by heating it to a red heat and allowing it to cool very slowly. Burying it in ashes is a good way to insure slow cooling. Any desired design can then be cut with a cold chisel or with hollow punches. The head may be taken to a machine shop to be expertly heat-treated to restore the original temper.—R. W. WAGNER

GREAT REPUBLIC MODEL

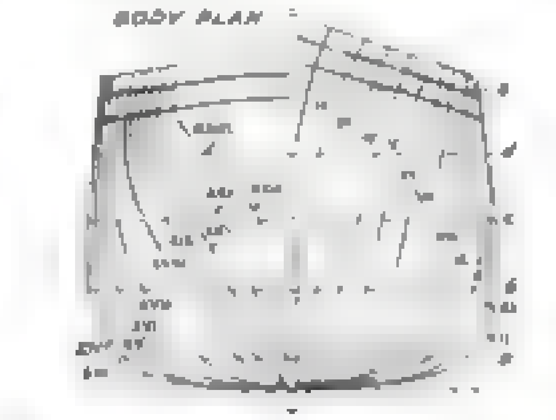
(Continued from page 61)

two moldings from end to end of the hull they are a full 1/16 by a bare 1/16 in. The upper one finishes at the quarters, and the lower one goes around the stern. Strip wood is the best for the moldings, but a piece of spline, celluloid, or fiber is easier to apply at stern.

Along the edge of the deck is a covering board 5/32 in. wide by 1/16 thick. This goes right around and extends 1/32 beyond the hull. It can readily be steamed to shape at the bow, but it is easier to cut a piece to shape at the stern. All around, along the middle of this, is a chock (timber) 3/32 by 1/16 in.

It saves trouble to mark in the deck planks before putting these pieces on. Plank marks 1/10 in. apart look well. The deck should then be given a coat of clear lacquer.

The size, shape and positions of the channels are shown on the deck plan, and also on the rigging plans to be published later. The



Body lines of the hull drawn to the same scale as the sheer and half-breadth plans

notches are for the chain plates. In both upper and lower channels they must be at the same angles as the shrouds and backstays.

The two hawse holes at each side for the anchor cables are bored as if to lead to the second deck. They must be carefully made but need not be deep. To form the lips of the pipes, I put oiled sticks in the holes and built the rims up with plastic material. They will be red inside.

The three oblong mooring ports at each side lead to the second deck. I merely indicated them with light V-cuts.

It would seem as if the ship ought to have a number of glass port lights, but I have found no indication or mention of them.

A hole 11/32 in. in diameter must be very carefully bored for the bowsprit. Start with a small drill and gradually increase the size, watching all the time that its vertical and horizontal angles are true. It should go in fully 1¾ in.

The rudder is hung in the usual way, with pintles and gudgeons. These can be made as shown in the detail, where I also show what makes an easier and neater job, with simple pin eyes in the sternpost and pin points in the rudder. The rudderpost must go a little way into the stern. The rudder also has preventer chains running from an eyebolt above the water line to bolts in the counter on either side. This assembly had better be laid to one side until later.

The *Great Republic* was sheathed in yellow metal (which looks like brass) up to the 25-ft. water line. The hull can be painted to represent verdigris-tarnished brass, or very thin sheet brass can be glued on—.001 or .002-in. sheet brass is suitable. To get the pieces so that they would fit properly I pinned a piece of tracing paper along the keel to rest smoothly on the hull and marked from the keel to line *a*, another strip from *a* to *b*, and a third from *b* to *c*. I cut the brass to these shapes; they may then be glued on without wrinkles. With a little sprocket wheel used like a marking wheel, I indicated the nail heads of the plates on the inner surface. (Continued on page 96)

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GREAT REPUBLIC MODEL

Continued from page 95

Stern view showing gilded eagle shield, and name. The base is of the graving dock type

of the brass. The actual plates were 14 by 48 in., but I marked them ⅛ by ⅛ in.—about double size—to save confusion. I found casein glue the best chiefly because it gives one time to work. I ran the edges part way onto the keel and then bent a strip to cover the keel and stern, here brass is fastened to brass, so I used cellulose cement. Brass is always sold coated with grease, which must be washed off.

At the stern there is a gilded eagle. This can be carved or molded with gesso or other plastic material. This and the figurehead are gold. The shield has white stars on blue, and red and white stripes below. The letters on the bow and stern are white.

All of the hull from the water line to the covering board is black. The latter and the chocks lying along it on top are white.

The catheads are square balks of timber with three sheaves in the end for the catfall. On the fore side are three eyebolts, and abaft is an arrangement for slipping the ring stopper of the anchor, the standing end of which goes to a bolt under the cathead. The chock, but not the covering board, will be cut through so the cathead lies nearly horizontal. On the ends can be painted or carved a cat's head.

At the quarters there are bumkins to spread the mizzen braces.

On the stem are two straps for the bobstays to shackle to. These are strips of sheet metal, riveted through the stem with pins, with their extending loops filed a bit smaller.

At about 2 in. abaft the catheads, the hull is padded out by the anchor linings, for the flukes of the anchors to slide on. Wood can be cut to fit, but plastic material is easier to use.

Now comes the job of strapping and fitting the numerous lower deadeyes. At the fore-, main-, and mizzenmasts six 3/16-in. deadeyes are needed, for the cap and topmast backstays four of the same size; for the topgallant two of ⅛-in., and for the royal one of 3/32-in. The skysail backstays hitch to eyebolts in the channels.

A chain plate (bar) may be made from No. 20 soft brass wire. Hammer it slightly flat all along, then thinner at the upper and lower ends. Bend the top end sharply to form a hook, file this back to the width of the rest of the wire, but spread the lower end as much as possible. *(Continued on page 97)*

GREAT REPUBLIC MODEL

(Continued from page 96)

The figurehead of the *Great Republic* still exists, and this drawing is from a photo of it

I make a deadeye strap of No. 32 wire soldered into the hook mentioned with enough slack to punch into the slots of the channel.

I put this assembly in position, mark where the nails will go, and drill the chain plate; then snip off the waste and, with [illegible] pins, nail it in place. When one of a kind has been measured and cut, the others are made to match, but, tending aft, each is a little longer.

The spanker-mast deadeyes are similar with four 1/8- and two 3/32-in. on each side. The chain plates here are shorter. To hold all the chain plates in position and give the right finish, thin strips of brass are nailed to the edges of the channels, starting on their ends.

Next month—the deck fittings.

List of Materials

SOFT PINE

No. of Pc.	Dimensions	For
[illegible]	[illegible]	Hull
[illegible]	[illegible]	[illegible]
1	[illegible]	Deck houses
1	[illegible]	Deck house tops
1	[illegible]	Hatches
1	[illegible]	Companion
1	[illegible] 10"	Skylight
1	[illegible]	Boats

GUM WOOD OR OTHER SEMIHARDWOOD

No. of Pc.	Dimensions	For
1	[illegible]	Keel
1	[illegible]	Stem
[illegible]	[illegible]	Sternpost and rudder
1	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
1	[illegible]	Chock
[illegible]	[illegible]	[illegible]
1	[illegible]	Catheads and knightheads
1	[illegible]	Bumkin
[illegible]	[illegible]	Channels
[illegible]	[illegible]	Fife rails
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Capstans

MISCELLANEOUS

[illegible] x 21" for deck houses [illegible]

[illegible]

[illegible]

[illegible] x 4" for tops.

[illegible] other material, [illegible] for caps.

[illegible]

Black	40	[illegible]	[illegible]
Brown	[illegible]	[illegible]	[illegible]

[illegible]

Belaying pins [illegible]

[illegible]

Paint: white, black, red, green, brown [illegible] lacquer or varnish. Glue, cement, plastic wood composition, etc.

HOME WORKSHOP CLUBS

(Continued from page 88)

a statement of the club history and purposes. The advantages of membership in the club were listed as follows: "The club affords a meeting place for the exchange of ideas. It conducts helpful programs and demonstrations of correct procedure in the use of hand and machine tools. Members make toys for distribution to children of needy parents at Christmas time. The club maintains a department for barter and exchange of tools, machinery, materials, etc. It provides opportunities to visit shops of its members, from which ideas may be obtained for improving one's own shop. At one meeting an expert from a tool company may demonstrate how to care for and sharpen tools. At another meeting a member may give instruction in wood carving, furniture construction, or the use of woodworking machinery." The club, which has been affiliated with the National Homeworkshop Guild for more than a year, draws its membership from an area extending to Laurel, Md., twenty miles from Washington.

Wood-Ridge (N. J.) Homeworkshop Club. Well-attended meetings have marked the renewal of fall activities. A trip by the members of the club was made to the plant of a large dealer in veneers and home workshop materials. Many rare woods were displayed, as well as several elaborately inlaid pictures. In discussing this type of work and the article about it in a recent issue (P. S. M. Oct. '35, p. 61), G. N. Schalk, the club secretary, was able to suggest several useful kinks he has developed in doing similar work himself. To clean off the rubber cement after attaching the picture to the core, he has made a tool by removing the metal flanges from six or eight circular erasers and mounting them on a thin bolt. They are clamped securely with a washer and nut, and the end of the bolt is placed in the chuck of a drill press or lathe. The picture is quickly cleaned by passing it over the revolving erasers. In the actual sawing of the pad of veneers with an .008-in. blade, the blade guides are not used and, of course, a slow speed is necessary, but in addition Mr. Schalk finds it best if the hands do not touch or rest on the saw table. A firm but gentle pressure of the finger tips alone enables the blade to keep itself straight.

Topeka (Kans.) Homeworkshop Club. Toys are being made for the Shawnee County Parental Home. . . . The club was well represented, along with other Kansas home workshop organizations, at the Kansas Free Fair. "Lop" Carlson was chairman of the exhibit committee of the joint home workshop clubs. . . . Clyde F. Cook, president, has announced the receipt of a $25 contribution from a member towards the Junior Topeka Homeworkshop Club. . . . The photography class is meeting regularly. Recent issues of the club news bulletin, which is a mimeographed booklet published once a month, have had illustrated covers and also have contained working drawings for several toys.

Three Rivers Homeworkshop Club, Three Rivers, P. Q., Canada. The one-member exhibition held each month continues to be an interesting feature of the club programs. Maurice Richard recently exhibited a child's costumer made from a POPULAR SCIENCE MONTHLY blueprint; Albert Ricard, a miniature grandfather clock with a special finish which he originated; J. Henri Dube, a magazine basket and a series of finger rings made as described in the March, 1935, issue of POPULAR SCIENCE MONTHLY, page 63; and Armand Bourassa, a governor of the club, a mirror with special plastic decorations. Mr. Bourassa gave a demonstration on how the decorations were applied.

TWO MODERN LAMPS

(Continued from page 83)

Drilling ventilating holes in column of table lamp. It is advisable to insert a turned block of wood in the tube to prevent cracking

the two squares and the socket together by means of two bolts and nuts. It is advisable to countersink the holes on the under side of the larger plate so that the bolt heads do not protrude.

The four smaller squares of sheet material not only serve as decorative legs but, by lifting the larger squares off the table, enable the lamp cord to be drawn away towards the source of current. They should be attached to the underside of the largest square section so that each protrudes ¼ in. on either side of its corner. This can be accomplished by drilling two holes entirely through each small square and partly through corresponding positions in the underside of the largest square. Countersink the under side of the holes in the small squares and insert small, short, flatheaded screws. These will cut their own threads, but care should be exercised not to force the screws to the point of splitting the material. If a screw jams, withdraw it and either redrill or ream the hole to a slightly larger diameter.

The upright column of the lamp is formed from a 7-in. length of the cylinder casing. Since this was originally more than 8 in. in length, it must be (Continued on page 10-)

The round top plate for the table lamp and end plates for the desk lamp are jig-sawed

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TWO MODERN LAMPS

(Continued from page 99)

cut to size on a band saw or with a back saw. The shallow decorative turnings are then applied to the cylinder, and a number of holes drilled near the top and bottom to provide sufficient ventilation to carry off the heat of the bulb that will be placed within the cylinder. To simplify turning and prevent cracking, turn a softwood mandrel to a diameter sufficient to let the tube slip over it with a snug fit. You will find that cast-resin cylinders have a slight taper—three or four thousandths of an inch over their entire length. To allow for this, you may find it advisable to paste one thickness of paper over the mandrel at the end near the headstock of your lathe.

In the lamp shown, three grooves about 1/4 in. deep were turned at 1/2-in. intervals at the top and bottom of the cylinder. Four

Cutting the opening in the desk lamp on a band saw. A circular saw also may be used

holes, 90 deg. apart, were then drilled through the tube between the first and second grooves, each being 3/16 in. in diameter. Similar holes were drilled in corresponding positions at the bottom of the tube. Any number of variations of this design may be made. The important thing is to avoid cutting too deeply into the cylinder and thereby weakening or fracturing it.

The last piece to make is the cap plate at the top of the upright column. This consists of a circle jig-sawed from sheet material and cut away in its center to permit the upper socket to protrude. Two small holes should be drilled 1/8 in. from the edge at opposite sides of this disk, and corresponding holes in the top end of the cylinder.

Small brass roundhead screws may be used to attach this piece to the cylinder or, if the holes are countersunk, flathead screws can be placed so that the heads are flush with the top surface of the material. Two other holes should be drilled partly through this top plate from the underside so that bolts can anchor the socket just below the plate.

After all pieces have been cut to exact size, but before assembling, each piece should be polished. Rough saw cuts should be finished off on a sanding belt or with sandpaper. The edge of the top plate should likewise be rounded by sanding. The actual polishing consists of two steps. First, a high-speed muslin-disk buffing wheel is used with a mixture of pumice and water of mud-like consistency as polishing agent. This should be followed (Continued on page 101)

TWO MODERN LAMPS

Continued from page 100.

The desk-lamp housing is pressed against a block of wood while hand-sawing the grooves

by a waxing with either Tripoli wax or a good grade of plain, clear floor wax, using a clean high-speed wheel. Finally, a dry buffing will bring out the highest degree of polish.

In wiring, the sockets should be connected in parallel, so that both lamps will light at once.

The cylinder will be found true enough and heavy enough to support the upper bulb and lamp while merely resting on the base. If, however, the lamp will be in a position subject to vibration or much handling, drill two holes up through the base and into the bottom of the cylinder and insert either small brads or plain wooden toothpicks. These will provide sufficient hold while enabling the cylinder to be removed when it is desired to change the inner bulb.

The desk lamp, in most respects, is made in the same manner as the table lamp. The main section of the base consists of a piece of sheet material 5 5/8 by 8¼ in. This is surmounted by two sections, each 3¼ by 4½ in. These are mounted, with the usual drilled holes and self-tapping screws, flush with the ends of the main plate, so that a ¾-in. space exists between the two smaller plates. Six additional pieces, each ¾ by 3¼ in. are used, three on each side, to buttress the vertical plates that support the light carrying section above. These buttresses are attached to the main base by means of screws rising from countersunk holes in the base plate.

Two vertical supports are cut from sheet material, each 3½ in. wide and 7½ in. long. Notches ¾ in. square are sawed out of the corners of the upper end of these plates with a hack saw.

The cylinder used in this lamp has a longitudinal section cut away to pass the light downward. The exact width of this section will vary with the type of bulb you use, it being necessary that the opening be wide enough to insert the bulbs after the lamp has been completely assembled. In this instance the saw cuts were made 2⅝ in. apart. To brighten the appearance of roundness when the lamp is finished, these cuts are made parallel to each other, so that as little as possible of the material is cut away to provide entrance for the bulbs. If you have a large band saw, cut the tube in an upended position. If not, use a circular saw, preferably hollow ground, and make the cut slowly to avoid overheating.

The section that has been cut away, if flattened on its bottom on a sanding belt and polished, will form a neat pencil and pen tray, as illustrated. *(Continued on page 102)*

SHOP DROPLIGHT SLIDES ON SWINGING TRACK

A CONVENIENT method of adjusting the droplight over a lathe or other machine is to attach two or more small pulleys to the extension cord in such a way that the lamp may be moved along a small rod, bent into a triangular shape and extending about

The droplight may be moved to any position on the rod, which may be swung to either side

4 ft. from the wall of the shop. The ends of the rod are flattened and drilled to take a short bolt, which holds them to a short section of angle iron, bolted into the wall. A short coiled spring on this bolt stiffens the action of the track rod.—JOSEPH C. COYLE.

TWO MODERN LAMPS

Continued from page 101

The next operation calls for cutting two grooves, each 3/16 in. wide and 5/8 in. apart, at either side of the opened portion of the tube. These grooves should extend back to the widest point of the tube. Make the cuts on a band saw, if available, holding the tube steady against a wooden block. If carefully made, the waste pieces will break away easily under slight finger pressure. Finally, finish these grooves so that they exactly fit the two vertical plates, cutting back, where necessary, with a file. You will find that the plates are about a thousandth of an inch thicker on one side than the other (all resins must be cast with a slight taper), so that one side will need slightly more filing than the other. If this work is done carefully, a tight fit will be attained, and no cementing or other means of attachment will be required. Under no circumstances force the flat uprights into the grooves or the center partition will crack.

The last two pieces needed are two jig-sawed circular plates, 3½ in. in diameter, to close up the ends of the tube. These are attached by means of small roundheaded brass screws inserted into drilled holes.

After polishing all pieces and assembling the base as previously described, drill the necessary holes and attach two small sockets of standard type to the upright plates so that each socket will be in the exact center of the tube when the plate is put into position. When the sockets are attached and wired, fit the upright plates into position and then attach them to the base by means of screws set upward through countersunk holes in the base. These must necessarily be of small diameter, as they enter endwise into a ¼-in. plate; it is therefore advisable to use three or even four screws, spaced evenly.

If you would like to see more articles on working with plastics published in that magazine, please send a post card to the Home Workshop Department.

HOW TO CONVERT A FILE INTO A HUNTING KNIFE

The knife and what it was made from—an old file, bits of leather and a scrap of brass

ALL that was required to make the high-grade hunting knife shown above was a worn-out 10-in. mill file, 10 cents worth of scrap sole leather from a shoe repair shop, and a piece of scrap brass 1½ in. in diameter. The latter was picked up at a junk yard for 7 cents.

Place the file in a forge or bury it in a roaring bed of live coals in a furnace or stove and bring to a white heat. Remove and let cool gradually. I have found that this will leave just the right temper for the blade of the knife.

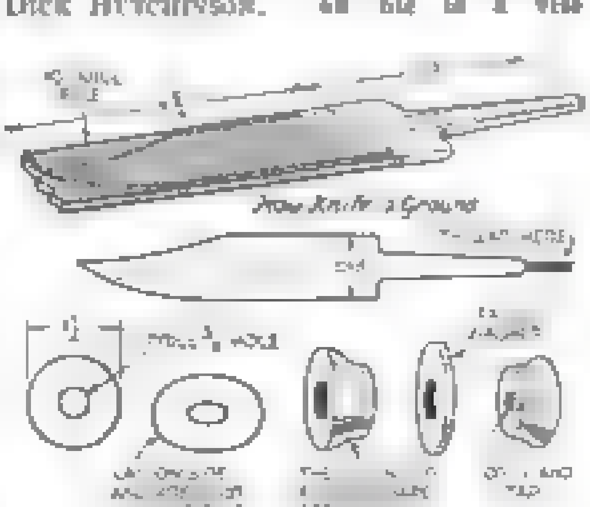
Now place the file in the vise with 3 in. above the jaws, and break it off even with the top of the vise by tapping cautiously with a hammer. Grind the file down to shape on a coarse wheel as shown in the drawings, and finish on a fine wheel, but do not put a knife edge on the blade until the whole is completed. Thread the end of the tang as indicated.

Shape the ferrules on a lathe or by grinding. Anneal the front ferrule by heating to a cherry red and plunging it into cold water. Then drill a ⅜-in. hole through the center. Place the piece on the anvil and drive down flat so that it will slip into place on the tang.

Cut the sole leather into approximate sizes. Drill or punch holes through the centers and slip them onto the tang. Drill and tap the end ferrule and screw it tightly on the end of the shaft, which has previously been threaded.

Let the knife stand for a few days until the leather has thoroughly shrunk, then turn up the end ferrule as tightly as possible. Finish grinding the handle to shape, polish the whole with fine emery paper, and buff on a buffing wheel. Shellac the leather on the handle, and grind the knife sharp.—DICK HUTCHINSON.

Method of breaking off file in a vise



WIRE DOLL FURNITURE

(Continued from page 69)

The round-bottom chair is made from three wire pieces and a cardboard disk for the seat

of the arms and is very important

The chair with the round seat is quickly made by bending a piece of wire around a round object for one and a quarter turns and bending the ends downward to form the front legs. The back of the chair and the back legs are bent from one piece and soldered in place. Then the decorative ring is added. The seats for all of the chairs as well as the table tops are made from cardboard.

For the larger pieces such as tables, a more rigid construction may be necessary. Heavier wire may be used, but a more ornamental method is to grip one end of two or three wires in the vise and twist them into a single bar with a hand drill or a carpenter's brace. The three-legged table thus constructed withstood a load of 51 lb. before one leg buckled.

While any of this furniture can be finished by painting, it was found that paint not only emphasized the slight irregularity of the wires, but also required several carefully applied coats to finish each piece. On the contrary, sealing wax covered perfectly with a single coat and produced a lustrous finish that was unobtainable with paint. The sealing wax, which is the kind sold for craftwork, can be obtained in a large assortment of colors, including gold and silver. Simply heat the wax over a small alchohol flame and dab a little upon the wire to be covered. Then hold the wire over the flame and let the wax flow evenly over the surface. It sets almost immediately.

The chair seats and table tops are finished by covering them with sealing wax, both top and bottom. They are then heated a little and stuck on the furniture. Another method is to cover them with bright-colored cloth.

Those articles made from twisted wire look well if the wire is thoroughly polished before it is twisted and then left without further covering except perhaps a coat of very thin transparent lacquer to prevent tarnishing. Black sealing wax makes a beautiful finish for the smaller furniture.

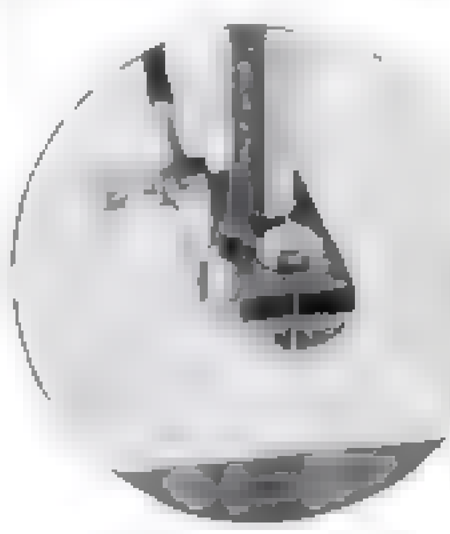
Twisting wire for use in the heavier pieces and, above, a good way to straighten old wire

PERFORATED PATTERNS MADE ON JIG SAW

Marking a design on wood for scroll sawing with aid of perforated stencil

WHEN it is necessary to duplicate the same design on a number of pieces of wood or veneer before cutting them on the scroll, jig, or band saw, much time may be saved by using perforated stencils. Merely lay the stencil over the work and gently daub it with a cotton pad dipped in lampblack. The design will be marked on the work in the form of minute dots, which are easily followed. If the designs are to be filled in with colored enamels, you can, if necessary, use dry pigments of the appropriate color instead of lampblack.

An easy way to make the perforated stencil is by clamping an ordinary needle in the jaws of the scroll saw. The needle should



The cardboard is pushed over the needle at a constant speed to form the perforations

clear the table by about 1/4 in. at the highest point. Set the saw for slow speed, and you will find it possible to perforate a sheet of lightweight cardboard merely by moving it at a uniform speed on the table. The same method can be used for perforating pads of note paper so that the sheets may be quickly torn into smaller portions and for various similar purposes.—E. A. BOWER.

GRINDING HIGH-SPEED DRILLS

IN GRINDING high-speed drills, care should be taken not to overheat them. When heated, they should not be plunged in cold water, because to do this is likely to cause small surface cracks, which may result in serious damage to the drill.—H. J. C.

YOUR MICROSCOPE SHOWS HOW PHOTOS ARE MADE

(Continued from page 47)

to explore in other directions. Have you been having trouble with frilling or reticulation? That is, do your negatives have that patent-leather look that every miniature-camera user, and many large-camera fans too, dread during hot weather? Examine a reticulated negative with your microscope, and you will find that the gelatin coating is full of tiny cracks or folds, formed when it contracted or expanded during a sudden change in temperature. Such reticulations are, of course, undesirable because they play havoc with the image when attempts are made to enlarge more than three or four diameters. Sometimes, no satisfactory print can be made at all.

WAYS of avoiding reticulation include keeping the temperatures of all developing, rinsing, fixing and washing solutions the same, generally between sixty-five and seventy degrees F. Another way is to harden the film in formaldehyde, as already described, either before development or at any other point during processing, so long as trouble has not already occurred.

You can have a lot of fun, and learn much about photography, by examining microscopically everything else in your darkroom or that of a friend. Natural-color films and plates are objects of dazzling beauty when seen at 100 diameters or so. Some of them exhibit a maze of colored starch grains, others show a fine network of colored lines. The various photographic chemicals—metol, hydroquinone, sodium sulphite, sodium carbonate, potassium bromide, hypo, paraphenylenediamine, and so on—can be converted into beautiful objects for microscopic observation.

Simply dissolve a little of the chemical in warm water, place a drop or two on a clean slide, and set it aside until the water evaporates. You will find the slide covered with a network of beautiful crystals. Such crystals make unusually beautiful objects for dark-field and polarized-light examination. In handling metol and paraphenylene-diamine, particularly the latter, keep the solutions off your skin as much as possible. Some persons are susceptible to skin poisoning from these chemicals.

And now, since you have learned that it is possible to produce small, fine-grained negatives that can be enlarged many times, and have begun to suspect that there is really nothing very difficult about doing it, why not apply this knowledge to the making of photomicrographs?

But I don't have the equipment," you object, and photomicrographic cameras cost a lot.

Would you consider a dime excessive, for such a camera?

THAT is about the cost of a "pill-box" camera that can be attached to your microscope and used to make excellent photomicrographs of just about anything that can be photographed with more elaborate equipment. The photomicrographs accompanying this article were made with such an attachment, which cost a total of nine cents.

Obtain from your druggist two cylindrical cardboard boxes about two and one half inches in diameter and four inches long. Stretch the lids slightly, until they will slip on or off easily, yet will not be excessively loose.

In the center of one lid cut a hole of a size that will permit it to slip over either the upper end of the microscope tube, or the tube of the removable eyepiece, depending on the design of the instrument. It may be necessary to fasten a short length of cardboard tubing over the hole, so that the lid can be clamped in place on the microscope. With a standard ocular the fastening (Continued on page 107)

YOUR MICROSCOPE SHOWS HOW PHOTOS ARE MADE

(Continued from page 106)

is simple. The ocular is pushed through the hole, and the knurled ring surrounding the upper lens clamps the cardboard lid against the end of the tube

In the bottom of each of the two boxes, centered with respect to sides, cut a rectangular opening measuring fifteen-sixteenths of an inch by one and three-eighths inch. This is the picture opening for this camera is to use thirty-five millimeters motion-picture film, the same as many popular miniature cameras and microscope attachments. Over one of the openings cement a piece of ground glass that is slightly larger all around than the opening, one and three-eighths by one and three quarter inches being about right. Place the glass with the ground side down. Use ambroid cement, the same as is employed for model airplane making, for holding the glass in place, and assembling other parts of the attachment. You can obtain ground glass from a camera supply dealer or make your own by rubbing one side of a piece of flat glass with a powdered abrasive, such as emery, mixed with water, using the bottom of a small bottle as a grinding tool

THIS completes the focusing part of the camera. Fasten the lid to the microscope, invert the box and lower it into the lid, and you can focus the image of the object on the ground-glass panel or screen. Of course, there must be sufficient light coming through the microscope. A short length of cardboard tube an inch or so in diameter and about the same length, can be set on the glass to make the image sharper by keeping out side light, if desired

The other cylindrical box is the film holder. Lay a piece of thirty-five millimeter movie film about one and three-quarters inches long over the rectangular opening, and center it as nearly as possible. Mark along the edges and across one end. Remove the film and cement strips of heavy paper or thin cardboard, whose thickness is but slightly greater than that of the film, along both sides. Across the marked end, cement a strip of thicker cardboard. Then, across the top, running from one side strip to the other, cement a rectangular piece of cardboard. This should be about one and three-eighths inches wide to match the length of the rectangular opening. Place it so that there is a narrow portion of the opening visible at the end where the cardboard strip was fastened. It is not a bad idea to cut a shallow V notch in the rectangular piece at this point. The purpose of the opening or V notch is to permit a knife blade or needle to be inserted for guiding the film (which has a tendency to curl) into place

This arrangement forms a shallow slot closed on the upper side by the cardboard piece, and having the rectangular opening beneath it. When a piece of movie film is inserted into the slot as far as the cardboard strip near the opposite end of the opening will permit, and excess film trimmed off with scissors, the camera is loaded. However, provisions must be made to keep out light until the exposure is made.

THE upper end (bottom of original box) is closed simply by pressing the remaining lid over it. The other end of the box is equipped with a simple cardboard shutter, which consists of a cardboard strip moving between two disks of cardboard having three-quarter inch holes in their centers. One end of the strip projects through a slot in the side of the box, forming a handle. A common pin held in place with ambroid cement forms a pivot about three-eighths of an inch from the side of the box. Suitable strips of cardboard are placed so that they form stops for the movable strip, and spacers be- (Continued on page 111)

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

MORE $5 PRIZE WINNERS

Three prize winning letters in POPULAR SCIENCE MONTHLY'S new Secrets of Success contest—"*What Home Study Has Meant to Me*"—are printed below. Read these stories carefully because your own career may be just as interesting and inspiring to other readers. If you think so, put it down on paper and send it in. We will pay $5 for every letter we publish.

CONTEST RULES

Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

We are interested in facts, not literary ability, but please write clearly, completely, and keep your letter within 500 words. We are not looking for "get-rich-quick" stories or freak adventures, and authors must be prepared to substantiate the truth of the statements. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless sufficient postage is provided for this purpose. Address your contribution to Success Story Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

HOME STUDY HELPED WEATHER THE DEPRESSION

In checking the advertisement of a client, in the September issue of your splendid magazine, I also read your comments on home study. I am prompted to write not just for the prize alone, to use your own words (although any young fellow who's going to be married in a few weeks can use an extra fiver) but that whatever success I may have enjoyed to date may spur someone else on to bigger and better things.

In the summer of 1927, at the age of 16, and following my graduation from a two-year commercial school, I obtained my first and only job in an advertising agency. The start was made at $5.00 a week and little by little, as I became more familiar with the routine of the business, my pay was increased, until at the beginning of 1929 I was being paid $10 a week.

I thoroughly enjoyed advertising work, but somehow I felt that I was making little progress—until quite by accident I came across a business reply card of a correspondence school, on the back of which was listed a number of business training courses, including advertising. As

Secrets of Success

I was curious to know if any such course could be of benefit to me, and as the card didn't require any postage, I filled it out.

Within a week's time I was enrolled in the complete advertising course and immediately my salary was raised $2. It required nearly a year's time to complete the course, and immediately upon receiving my diploma, the whole business world was plunged into what is now referred to as the worst depression in history. Our business was no exception, and we were forced to retrench in many ways.

Men and women in every branch of industry and business were thrown out of work. Money was scarce. Jobs were scarcer, and obtained and held only by the thoroughly trained!

And that is why I am thankful that I had the good fortune to acquire a training in home study. Through it all I was lucky enought not only to keep my position, but to enhance considerably my earlier income, and I believe the home study was an invaluable aid in bringing this about. And on top of this, the future for our agency looks brighter than it has at any time in its history.—*C. J., Ft. Wayne, Indiana.*

FEELS SECURE IN HIS JOB

On completing my school days, I was compelled to seek work to help with the family finances. Drifting from one job to another, getting nowhere, I decided to learn a trade. I tried collar cutting but it did not appeal to me. Then I started in as a machinist's apprentice at the Watervliet Arsenal, Watervliet, N. Y. and it was here that I discovered what was to be my particular niche.

Machinery appealed to me, I found I wanted to know more about it. I wanted to design, to plan, to figure the strength of materials, etc. I sought advice and was strongly urged to continue studying in what I had now determined was to be my chosen profession.

I enrolled as a student in mechanical engineering with the ——— School. Studying alone seemed rather difficult. Many a time I was discouraged and was tempted to give up. But I conquered myself and completed the whole course. In order to get practical experience in drafting, I made a connection with the ——— Cash Register Works as detail draftsman in the tool, jig and fixture department.

The remuneration was small, but the experience gained more than made up for the meager pay. Approximately four months later, the company had to reduce the force in the drafting department and because of my shop experience I was transferred to the toolroom. It was very much against my wishes but I had to be content until I could make another connection. This I did with the engineering department of the ——— Locomotive Company as draftsman.

Here I received more money than in my previous position, due to my increasing experience and training and a year and a half later I had another raise.

THE TYPICAL I.C.S. STUDENT!

When people refer to the International Correspondence Schools as competitors of other educational agencies, they speak from inaccurate impression and not from established fact.

Let's take a look at the typical I.C.S. student—an average of over 4,000,000 students during the past 40-odd years:

He is 27 years old. He works. (Interestingly enough, you seldom see an I.C.S. student out of work.) He is married. He is a parent. In appearance, he is a composite of office and shop worker.

He comes to I.C.S. because of a specific need for a specific kind of training.

Recognizing his own shortcomings in training, and influenced by the recommendations of his superiors and associates who know by personal experience the value of spare-time study under expert instruction, he approaches his I.C.S. course with hope and determination.

Where else, in view of his circumstances, could he turn? *This is the place of the International Correspondence Schools in the American educational picture—a place honored and commended by thousands of ambitious men in hundreds of professions and trades today and by educators from coast to coast!*

AN INVITATION

Men who are anxious to get ahead, to earn more money, and who are willing to pay the price in hard work and sacrifice of pleasure, are invited to consider this coupon and the subject most vital to them. *But men who think some magic force of fortune goes into action in their behalf at the drop of a coupon without any further effort on their part, should save their stamps and our time!* Our invitation is to the courageous.

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 3965-H, SCRANTON, PENNA.

★ Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the subject *before* which I have marked X ★

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☐ Structural Engineer	☐ Patternmaker ☐ Reinforced Concrete	☐ Automobile Mechanic	☐ Chemistry ☐ Pharmacy
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Name ..... Age ..... Address .....

City ..... State ..... Present Position .....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

Secrets of Success

(During all this time I had continued to study in my spare time)

About two and a half years later, I made another change of jobs with another pay boost, going to work for the State Department of Architecture. I was here only six months when the opportunity for which I had been waiting presented itself. A manufacturer of machinery needed a factory superintendent. I qualified for the position and was put in charge of the manufacturing rice and coffee hulling machinery for the ——— Huller Company. It was a real job, with real responsibility and a real salary that was advanced several times up to the time of the depression.

This, of course, affected our business like all others and I had to take a reduction, but with all that I feel secure in my job and on October 1, 1935 I rounded out eleven years of service with this company. I am gratified that I took that step years ago and studied in my spare time. I am sure that if I had put it off, I would not have been able to have held my present job and quite likely might today be listed among the millions of unemployed.—*J T., Jr., Syracuse, N. Y.*

A PROFESSION THAT'S NOT OVERCROWDED

From my own experience I believe that one of the best lines of study for young people today is optometry.

There are thousands of people going around nearly blind for want of glasses or ruining their eyes with cheap trash. Many do not know what a boon glasses are until they are properly fitted. Having gone so long with defective eyesight they have become accustomed to the handicap.

The writer realized this some time ago and took a correspondence course with the ——— College of Optics. Shortly after my graduation, our State passed its optometry law. I successfully passed the examination and was admitted to practice. But being in another business—jewelry—I only practiced optometry occasionally.

During the depression my business suffered so badly that I closed it out. Fortunately I was able to make arrangements with another jewelry firm to open an optical department where I have made more money the past year than I did all the time of the depression.

I believe there are openings in nearly every good sized town for one or more optometrists—many more than there are for doctors, dentists, lawyers, etc. of which our colleges are turning out thousands who cannot make enough to keep soul and body together. I advise young men and women who are adapted to this kind of work to take up the study of optometry. I am only sorry I didn't do it sooner myself.—*C.S.W., New Kensington, Pa*

PROTECTING MAGAZINE COVERS

If your magazines receive much handling, coat the covers with shellac so that they will last longer.—K. M.

YOUR MICROSCOPE SHOWS HOW PHOTOS ARE MADE

(Continued from page 107)

tween the disks. The distance from the disks when in position, and the open end of the box, is just sufficient to permit the handle of the shutter strip to clear the edge of the lid attached to the microscope tube.

Paint the interior of the box, exposed surfaces of the shutter mechanism, and all parts of the film-holding portion, with black India ink, to prevent reflection. In fastening the shutter in position, first cement three or four pieces of cardboard to the inside surface of the box to form ledges. Then cement the shutter against the ledges, run a length of heavy cord around the crack between shutter and box sides, and apply a coat of black lacquer, asphalt varnish, or similar sealer to make the joint perfectly light-tight. Finally, mark the ends of the shutter-arm slot "shut" and "open," and your camera is ready to use.

YOU can use in it any type of thirty-five-millimeter motion-picture film, or other film cut to suitable size. However, there are several advantages in using positive motion-picture film for most work. This film is cheaper than negative stock. It is not sensitive to all colors of light, which enables it to produce sharper images, when used with microscope lenses not corrected for photography, than a material sensitive to all colors. Positive film can be handled by a Wratten safelight lamp (type OA), which gives an orange-yellow light. It produces a very fine-grained image even with ordinary developers. And, finally, it is fairly contrastive under most conditions, which is of advantage in photomicrography. Another excellent film, when red and orange color-sensitivity is desired, is quarter-speed panchromatic, which must be handled in darkness or by a special green safelight lamp. When yellow or green filters are used—these produce a sharper image with ordinary microscope lenses—orthochromatic film is best.

Although good results can be obtained by developing positive film in ordinary developers, the employment of a fine-grain developer is advisable for other negative materials. The so-called borax developers are moderately fine-grain in action. However, for the finest possible results, a paraphenylene-diamine developer occupies top position at the present time. Such a developer can be mixed as follows: Water (about 125 degrees F.), fourteen ounces; sodium sulphite, 585 grains; paraphenylene-diamine, sixty-five grains; and glycine, eighty grains.

Let the solution stand for at least twenty-four hours after mixing. Filter before using. It can be used over and over for several weeks, or even months. Develop twenty minutes at seventy degrees F. If the highly purified paraphenylene-diamine hydrochloride, known as PDH, is used, it may be necessary to increase, perhaps even double, the time. Keep this developer off your hands.

IN THE matter of special developers for positive motion picture film, the best course is to consult the manufacturer of the film being used. However, if you want to try a fast-working developer, which also is excellent for most printing papers, the following formula will be of interest: Water (70 degrees F.), sixteen ounces; metol, fifteen grains; sodium sulphite, one-fourth ounce; hydroquinone, fifteen grains; sodium carbonate, 200 grains; and potassium bromide, ten-percent solution, fifteen to thirty drops.

Develop until the image looks dense enough by transmitted light, which usually will require from one to three minutes.

Previous articles of this series have discussed the use of filters, substage diaphragms and other means of improving the operation of the microscope for making pictures.

MIDGET MOTORED MODELS RACE IN AIR AND WATER

Continued from page 36)

of the mother skiff, leaving a curving trail of foam behind. The race is on.

In some contests, the average speed for five laps determines the winner. In others, the fastest time made on any single circuit is the basis of the decision. Each boat runs until its fuel gives out. Then it is reeled in and the next entry charges off in an attempt to better its mark.

Speeds of from twenty to twenty-five miles an hour are common. Unofficial reports from England tell of a thirty-nine-inch model with a twelve-inch beam that was clocked at forty-eight miles an hour when its single-cylinder power plant was driving it at top speed.

While most model motor-boat racing fans make their own engines, some have adopted Brown or other commercial jobs for use in their boats. Eastern enthusiasts seem to favor air-cooled motors; western racers water-cooled ones. One of the most popular of the latter type is turned out by Maynard Clark, of Arcadia, Calif.

HIS power plant has a single cylinder of gray iron with a detachable cylinder head of aluminum alloy. Water for cooling it is scooped up either through an opening at the step of the baby hydroplanes or through holes in the metal struts supporting the propellers.

Oftentimes, the compression ratio in these two-cycle, single-cylinder power plants is terrifically high. It may reach fourteen to one, producing a bearing pressure of about 800 pounds on the half-inch drill-rod crankshaft. To withstand such punishment, the racing engines have to be turned out with infinite care. Twin carburetors often feed the combustion chamber when the power plant is in action.

The usual motor placed in the official one-meter, or 39.37 inch, hull for racing has thirty cubic centimeters piston displacement. At times, these Lilliputian engines wind up to 8,000 revolutions a minute. In a sixteen pound boat they will turn a three-inch propeller of six inch pitch at such speed that the quarter-inch drill-rod shafts have to be case-hardened to stand the strain.

In shallow lagoons, like the Conservatory Lake at Central Park, in New York City, contestants wear arm-pit wading boots. A swivel-topped pole at the center of the pond forms the hub about which the racing boats whirl at top speed in their five-lap races against the clock.

Stability as well as speed, is essential to a winning racer. In this year's Walter Elliott Trophy race, Theodore Schoch's Blackhawk started off at a terrific clip. It was scudding over the water at more than thirty miles an hour when it suddenly nose-dived below the surface with a loud hiss. Another entry was traveling at peak speed when it struck a small floating object. It hurtled into the air, turned over and landed upside down, out of the race.

OCCASIONALLY a thrill that isn't scheduled on the program occurs when one of the competing boats breaks the line that holds it. Running wild, it usually ends by ramming the bank full tilt, tearing the engine to pieces and smashing the hull.

Consequently, some model makers try to safeguard their boats by attaching a six-inch aluminum tube to the ignition switch. Then if the model gets loose, the engine can be stopped by hitting the switch with a sweep of a bamboo pole.

Another plan is being tried out by nineteen-year-old Lathel Morris, Jr., a Venice, Calif. enthusiast. He is experimenting with radio control so he can govern the maneuvers of his racing model from the shore or from on board a larger boat.

(Continued on page 113)

MIDGET MOTORED MODELS RACE IN AIR AND WATER

(Continued from page 112)

Morris designed and built a perfect little four-cylinder, four-cycle motor which is only ten inches long and seven inches high. He spent more than a year in his back-yard workshop completing the engine. It is made largely of aluminum alloy and has a bore and stroke of one and one sixteenth inches.

In designing and testing these midget racers, hobbyists are learning things which may prove of value when applied to larger craft. For instance, one California builder has discovered that a flat, horizontal fin, placed on the strut back of the propeller, will end porpoising, or bucking, without reducing speed.

Similarly, in the field of airplanes, gas models are leading the way to new discoveries. In Kovel's machine, the center of gravity is placed fifty percent back from the leading edge of the main wing, instead of thirty percent as is customary on most full-size ships. In addition, the area of the tail surface is increased to thirty percent that of the main wing. The result, tests have shown, is a stall-proof ship. Time and again, as the plane has lost speed in climbing too steeply, it has simply floated downward in a gentle curve, instead of stalling and diving violently in the manner of the conventional airplane.

ONCE at Roosevelt Field, the model was only fifteen feet from the ground and climbing steeply on the take-off when the engine cut out as the result of a clogged fuel line. Instead of diving into the ground, it simply leveled off and slid to a normal landing. The innovation which has made Kovel's plane virtually foolproof could be applied to large machines as well.

Both in the sport of racing miniature *Miss Americas* and in flying planes powered with real gasoline engines, enthusiasts are experimenting with a thousand and one innovations. As a result, their hobby is turning into something more than a sport packed with thrills and fun. It is developing into a proving ground for new ideas, ideas that some day may be of far-reaching importance.

FIND CARBON MONOXIDE IN TOBACCO SMOKE

THOSE who object to sitting in a smoke-laden atmosphere may find support from a recent experiment at the U. S. Bureau of Mines, in which three research workers shut themselves up in an unventilated chamber and smoked sixty cigarettes, twenty-four cigars, and an ounce of pipe tobacco. Their discomfort was explained when air analyses showed the presence of both carbon dioxide and carbon monoxide, and blood tests showed that the subjects absorbed as much of the latter, poisonous gas as would be the case in walking along a street crowded with heavy traffic.

TOBACCO PLANTS SHOW SOIL DEFICIENCIES

Testing soil by growing tobacco plants in it, as a substitute for elaborate chemical analysis, is a possibility suggested by recent U. S. Department of Agriculture experiments. Absence of any one of nine essential elements for the growth of crops, the tests show, gives the broad, sensitive tobacco leaves a distinctive appearance. Shortage of nitrogen tinges the whole plant an abnormally light green color. A deficiency of phosphorus, on the other hand, gives it an extremely dark green hue. When calcium is missing, tips of young leaves forming the bud take on a characteristic hooked appearance. Equally telltale signs denote a lack of potassium, magnesium, boron, sulphur, manganese, and iron.

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

TRAINED EYES IDENTIFY 100,000 HUES

(Continued from page 45)

to you and refuse to give his opinion. For it is impossible to judge a color accurately, with rare exceptions, except by actual comparison with another color sample.

Behind the necktie or dress you are wearing may be thousands of dollars worth of dye testing, to make sure that the colors will not do a quick-change or disappearing act under conditions they are likely to encounter. After the color expert's eyes have found a certain dye sample satisfactory as far as hue is concerned, the dye has to go through a long series of fastness tests, which reveal whether or not it will retain its color in the face of severe treatment.

The dye is applied to different fabric samples in various ways. Perhaps the color would be affected by using a copper kettle for dyeing. This must be determined by actual test. Maybe it will fade when the cloth is wet with perspiration. It is therefore tested by being subjected to synthetic sweat. Several washing methods are tried, with water of various temperatures. The effect of bleaches such as those used by laundries is determined. The samples are ironed at different temperatures.

IN SHORT, the dye is tested in every conceivable way, to determine just how it will behave. The results of a series of tests are combined into a novel record, which consists of a strip of cloth on which all the test pieces are sewed, together with necessary information. Some of these test reports reach a length of fifteen feet.

Many important dyes formerly were imported from other countries; but today the quality of dyes made in this country is as high as that of any foreign product and usually higher. Dr. Rose points out. Something like three percent of the dye material used in the United States is imported, and most of this is of the nature of specialties, protected by patents.

Frequently, the introduction of a new product depends on the availability of dyes for coloring it. Chemists have produced many new and promising plastic materials which are being kept off the market because successful dyes and methods for coloring them have not been perfected. Dye chemists are at work, and the new materials will appear in due time, for it is seldom that the modern color wizard must admit defeat.

Sometimes, however, the dye expert must say, "It can't be done." Dr. Rose receives numerous requests for compounds that will "dye something light." This is an impossibility, because the addition of any dye always darkens the material, that is, it always makes the material absorb more light than it did before. The only way to make anything lighter is to bleach it or otherwise remove the color.

IN THE matter of paper, the dye chemist seems to violate this rule. Did you know that every piece of paper produced, even the white, is dyed? Natural cellulose or wood pulp from which paper is made has a yellowish hue, possibly with some other color present. To render the paper more white in appearance, a dye of a complementary color is used. That is, a color is used that, when combined with the color already present, will produce white. Thus, a yellowish paper is treated with blue dye to make it white, just as the laundress adds blueing to the rinse water to make yellowish clothes whiter.

Although this dyeing of paper makes it whiter, it actually makes it less bright. To the ordinary eye, however, the increased whiteness more than makes up for the slight loss of brightness. Tests with a photo-electric cell can reveal startling facts about paper samples. Thus, of two sam- (Continued on page 115)

TRAINED EYES IDENTIFY 100,000 HUES

(Continued from page 114)

ples, one may be whiter than the other to the human eye, but actually less bright to the electric eye. Sometimes, the quantity of dye used for tinting paper is very small. In one instance, three sixteenths of an ounce of blue and one sixty-fourth of an ounce of red dye was used for every 1,000 pounds of dry wood pulp.

Dyes are put to so many uses that the Du Pont laboratory must carry on research in many directions. In the laboratory are found machines for printing designs on cloth with sample dyes, equipment for duplicating, on a small scale, the dyeing processes used in making leather goods; miniature paper-making plants, and various pieces of equipment for aging or developing colors.

ONE thing that catches the eye of the visitor to a modern dye laboratory or plant using certain kinds of dyes is that the dye solution may be colorless, while the finished material may have a most brilliant hue, or dye of one color may produce a color entirely different when applied to a material. The so-called vat and insoluble azo colors are peculiar in this respect. In the vat process, the dye, which may be of one color in solution, is changed chemically after it is in the cloth, to produce the desired color. In naphthol dyeing with insoluble azo colors, colorless materials are combined to form colored dye molecules which are firmly embedded in the fibers of the cloth. Colors are aged or developed with steam, acetic acid, and other treatments.

Aside from their widespread use for coloring cloth and paper, and making printing inks, dyes find numerous other interesting applications. For tracing underground rivers, finding sewer leaks, and checking the flow of other underground waters, fluorescein, a well-known dye that gives off a greenish-yellow glow when acted upon by light, is used. The average person can detect one part of fluorescein in 100,000,000 parts of water.

Modern photography would be handicapped seriously without certain dyes used for making films and plates sensitive to green, yellow, and red light. Embalming fluid, largely composed of formaldehyde, is colored so that embalmed bodies will look pink and therefore more lifelike. The United States Department of Agriculture requires that certain imported seeds be dyed so that farmers can identify them. One method commonly used for dyeing seed is to mix it with the dye solution in an ordinary concrete mixer. In garages and machine shops, a paste containing a dye commonly known as "bearing blue" is used to test the trueness of bearings and other surfaces that slide over each other.

NOT long ago, Dr. Rose received a request for dyes that would withstand the weather when applied to the feathers of living chickens. The chickens were to be marked so that they could be identified during certain scientific experiments.

Among the most unusual uses for dyes is the production of artificial clouds. In England, such clouds of various colors are used in connection with the projection of aerial advertisements by means of giant magic lanterns.

The jackets around hot dogs are colored with a harmless dye to make them look more appetizing. Pecans and walnuts commonly are given a more attractive color by dyeing their shells.

In fact, if dyes were removed suddenly from modern industry, the world would be much more drab and dreary than it is. And if nature, ages ago, had not built a marvelous color-sensitive mechanism into the human eye, science might still be trying to find a convenient and reliable way of matching colors.

ARE YOU DRIVING A ROLLING ICE BOX?

(Continued from page 58)

motor happens to be running on a pretty thick mixture, the heater pipes may get nearly red hot after a long pull up a mountain road, and if anything that'll burn is touching 'em, off she goes!"

"Doesn't look as if it's really safe to use exhaust heat, then, does it?" Harkins commented.

"Not unless you can get rid of those two possibilities. One way would be to use the exhaust heat to boil water and send the steam through a small radiator."

"I WAS thinking of installing a hot-water heater in the car I had last year," said Harkins, "but a friend of mine put one in his car and it didn't work so well. On fairly warm days he got too much heat, and on cold days there was hardly any. Then, another fellow put one in and he didn't get any heat to speak of in any kind of weather. I guess the hot-water heaters may be safe but not so good at heating."

"You're all wrong there," Gus maintained. "Till the car makers get wise to the fact that every car used anywhere in this country except the South ought to have a built-in heating system, one of the best solutions is the hot-water heating units that are sold separately for installation in any car.

"Come over here and I'll show you why those two outfits you mention didn't work," said Gus as he led the way to a sedan, opened the door to the driver's compartment, and lifted the hood on one side.

"Now, here," he explained, pointing to a rectangular fitting under the dash, "is the hot-water radiator that heats up the air in the car. It looks like a small edition of the radiator on the front of the car and, in fact, that's exactly what it is. There are a lot of different styles of these hot-water heaters made at all kinds of prices. Any of them will give you heat, but, of course, the more expensive models are better made and will last longer.

"They all have a built-in electric fan that operates from the car's battery—takes very little juice—and most of them have shutters of one type or another so you can control the direction and strength of the blast of hot air blown through the fins of the heater."

"What makes the water circulate through those pipes to the heater?" Harkins inquired, as he peered under the hood and noted the two pipes that led forward from the heater and connected into the cooling system. "Seems to me that heating radiator is below the level of the top of the car's radiator. Besides, the pipes sag down so far there couldn't be any natural circulation as there is in a hot water house-heating plant."

"I WAS just coming to that," Gus went on, "and the answer is right in this fitting." He placed his fingers on a tubular metal section connected into the upper hose of the motor's cooling system above the junction of one of the pipes from the heater unit.

"Water can flow through this thermostatic valve," he explained, "only when it gets up to a certain heat. During cold weather, which is the only time you want the heater to do business, the valve never stays open all the way. That means the water pressure developed by the circulating pump forces some of the hot water from the cylinder jackets through the car-heater coils."

"My engine has a thermostatic control, so I won't need one of those," Harkins observed.

"You certainly will," Gus asserted. "The thermostat on your car is fitted into the top of the engine block and there's no way of connecting the pipe to the car heater so that thermostat (Continued on page 117)

Statement of Ownership, Management, etc. [illegible] of Popular Science Monthly, published monthly at New York, N. Y. [illegible]

[illegible]

Signed, A. L. Cole, Business Manager.

Sworn to and subscribed before me this [illegible] day of [illegible]

[illegible] Notary Public, Kings County Clerk's No. [illegible], New York County Clerk's No. [illegible]

My Commission expires March 30, 1930.

ARE YOU DRIVING A ROLLING ICE BOX?

(Continued from page 116)

will divert any water into the heater pipe.

"Look here," he went on. "If the flow of water is shut off by the thermostat before it starts to flow into the hose, there certainly can't be any pressure to force water into a branch line. Probably the lack of a properly placed thermostat was what was wrong with your friend's car—the fellow who got heat on hot days and none on cold days.

"Of course, when a car is going reasonably fast, there is enough pressure in the upper hose connection of the engine to cause a little circulation through the heater, so when the regular thermostat opened all the way on a warm day, the heater got busy. On a real cold day, when he needed heat, the thermostat didn't open all the way, there was less pressure in the upper hose and the little bit of hot water that still circulated didn't do any good."

"IF YOU get water circulation through the heater when you're going at fair speed and the thermostat is open all the way, why not just take out all the thermostats and let it go at that?" Harkins suggested.

Gus smiled. "That would spoil things for fair. On cold days when you wanted heat the fast water circulation would keep all the water, and the engine as well, so cold you wouldn't get enough heat out of the outfit to warm a flea."

"Now I begin to see it," Harkins said. "If you have a special thermostat on the job you actually get a little more circulation of hot water—and the thermostat will make sure it is hot—through the car heater on cold days than you do on warm days. Is that how it works out?"

"That's the general effect," Gus agreed. "Of course, you control the amount of heat you get in the car by regulating the shutters and by turning on and off the electric fan that blows air through the heater. And it shouldn't be much of a job to have the fan operation controlled thermostatically, too."

"How about the fellow I mentioned who didn't get any heat at all in any kind of weather? What was the matter with his outfit?" Harkins asked.

"Assuming it was properly installed, and one of the feed pipes wasn't clogged up," Gus replied, "then it's pretty sure that the heater itself was airlocked. Every one of these hot-water heaters has a little valve at the top to let out the air, the same as you have at the top of every hot-water radiator in the house-heating system. You have to let the accumulated air out every so often or the circulation stops."

"I OUGHT to have figured out it was something like that," said Harkins, a bit sheepishly. "I'll bring the car in next week, when I can spare it, and have you put in one of those heaters."

"You won't regret it," Gus smiled. "I never saw a man yet who once owned a car with a real heater who was willing to go back to a rolling ice box again!"

STEEL IS PLATED WITH BRIGHT ZINC COATING

PERFECTED after a long period of research, a new electroplating process deposits a bright zinc surface on articles of steel and renders them rustproof. The developers of the process claim that it meets the present-day need for a more economical method of making steel rust-proof while at the same time giving it a bright, decorative appearance. They expect "bright zinc," as the finish is called, to find widespread use in the automobile and radio fields, and in many other industries.

CAN YOU PROVE WHO YOU ARE?

(Continued from page 41)

many hospitals, the fingerprints of the mother and the footprints of the baby are placed on a card in the maternity ward to insure against mix-ups. Other methods of ensuring that the right mother gets the right baby, include placing tags and beads on babies to identify them and stenciling numbers on their skins by means of mild, nonirritating sunburns produced with an ultra-violet lamp.

A few years ago, fingerprints and a queer twist of fate solved a carefully planned fake suicide case at an eastern resort.

After a busy Sunday, attendants at the Far Rockaway, N. Y., beach were cleaning up the bath house when they found a man's clothing, hanging in one of the rooms. Apparently it belonged to the victim of an accidental drowning or suicide. Police were called and found a business card in one of the pockets. It identified the man and led to the discovery that he carried considerable insurance. Immediately, the police were suspicious but weeks went by without a trace of the missing man.

THEN, on a main street in Montreal, Canada, an automobile ran down a pedestrian and he was carried unconscious to the hospital. In trying to identify the victim, police found a pocket of clippings in one pocket relating to the Far Rockaway disappearance. The description of the missing man and the appearance of the victim tallied exactly. Fingerprints proved his identity beyond the shadow of a doubt and he confessed that he had taken two suits to the beach and left one in the locker room as part of a plot to mulct the insurance company.

In connection with fingerprint work, an eastern expert recently announced he had discovered a method of injecting special chemicals into the ball of the finger in order to obtain perfect fingerprints from bodies which have lain unburied for many days.

Wriggling thumbs, not long ago, helped a man win a share in a $[illegible],000 trust fund in New Jersey. Three times he stood up in court, extended his arms, and wriggled his thumbs until they projected at right angles to his hands, apparently dislocated at the joint. Two medical experts testified that the claimant's mother, acknowledged to be the daughter of the man who had set up the trust fund for his grandchildren, had suffered from congenital dislocation of the thumbs, the same rare condition the man had shown the jury.

In other cases, a combination of hereditary characteristics, such as the shape of the head, the nose, the ears, are used in court to show relationship and prove identity.

THREE years ago, the New York criminologist, Dr. Theron W. Kilmer, announced in POPULAR SCIENCE MONTHLY a system for classifying human ears. It culminated ten years of research during which thousands of ear pictures were taken and compared. Kilmer's work has been the basis of further study by scientists and police officials. At the University of Vermont, for example, Prof. Henry F. Perkins has listed 150 characteristic forms of ears, certain ones appearing in a family from generation to generation.

The color of your eyes and the number and direction of the whorls in your hair are other simple traits that have a direct bearing on your identity.

In the work of comparing eye colors, experts employ a special chart containing forty shades of blues and grays and browns. They range from albino to darkest brown. Parents with "genetically blue" eyes, that is, entirely lacking in brown pigment, never have brown-eyed children.

As for your hair, whether the whorl, or crown, turns clockwise or counterclockwise is of vital importance. Prof. Felix Bernstein, of Columbia University, has established the fact that the direction of the whorl is inherited. Also, double whorls, or two crowns, form another hereditary distinguishing mark.

Recently, marvelous work has been accomplished in restoring bodies as an identification aid. With moulage, chemicals, and make-up materials, police specialists in several cities have repaired badly injured faces and bodies of murder victims and helped friends identify them.

A study of bones and an examination of teeth also give clews that help a missing-persons sleuth. In the work of the New York bureau, alone, hundreds of dental charts have played their part in revealing identity when other means have failed.

NO TWO cavities are exactly alike. No two dentists use identically the same technique. And each man can recognize his own handiwork. So dentists' charts, showing the teeth and fillings in a patient's mouth, are often of prime importance. From an examination of the teeth alone, on a number of occasions, victims of long-ago murders have been positively identified. Time and again, the dentist and the detective have worked hand-in-hand.

The most recent and dramatic instance of the sort was the solution of the "ogre murder" in New York City. It culminated a relentless six-year search for the fiendish slayer who, on Sunday, June 3, 1928, kidnapped and murdered ten-year-old Grace Budd.

Her mother allowed her to accompany an elderly stranger who said he wanted to take her to a picnic. The stranger disappeared and the child was never seen alive again.

For six years, Detective William King, who vowed never to give up the case until he had solved it, followed literally thousands of false clews. Finally, in December, 1934, a letter enabled him to catch up with the slayer, sixty-five-year-old Albert H. Fish.

At headquarters, Fish confessed he had ridden to a century-old, deserted mansion on the outskirts of White Plains, N. Y., where he had murdered and dismembered the child. Digging where he told them, detectives unearthed a skeleton. Doctors testified it was that of a ten-year-old girl. But that was not enough. To convict the murderer of his crime, it was necessary to prove absolutely the bones were those of Grace Budd.

So King began searching to find a dental chart. The child had had no regular dentist and the hunt seemed hopeless. However, the detective already had proved himself a human bloodhound. He wouldn't give up. He tried every clinic the little girl might have visited and at each examined the records. The result was failure. He interviewed every social-service worker he could find who had been stationed in the neighborhood and who might have provided dental service for the child. Again, the result was failure. Finally, he reached the Northern Dispensary, at Waverly Place and Christopher Street in New York City. Here, forgotten among the records, was a card bearing the name "Grace Budd."

ORDINARILY, such cards are thrown away at the end of five years but by a twist of fortune this one had been overlooked. It provided the essential link in the chain of evidence against Fish. Without it, the diabolical killer might have escaped by a legal technicality.

On police records, in almost every state in the Union, you will find similar stories of success—success achieved through the cooperation of detectives and outside specialists. Criminology is learning the language of many sciences. And, in so doing, it is discovering new aids to its vital work of identification.

EASY EXPERIMENTS SHOW MOLECULES IN ACTION

(Continued from page 53)

its vapor pressure to balance the external pressure and permit the water to boil.

The experiment just concluded suggests a useful new way to define boiling temperature. When is a liquid at the boiling point? By rough observation, you know it is boiling when rising bubbles violently agitate its surface. A better definition of the boiling point is the highest temperature, as shown by a thermometer, to which you can raise the liquid by heating it in an open vessel. A still more exact definition, based on the experiment you have just performed, can now be given. The boiling point of a liquid is the temperature at which its vapor pressure equals the pressure of the atmosphere.

YOU can apply this useful new method to measure the boiling points of various liquids, such as alcohol or carbon tetrachloride. Place a few drops of the liquid under test, instead of water, in your mercury pressure gauge. Heat the J tube, as before, in a beaker of water, which should be warmed slowly. When the mercury columns are at the same level, read the temperature of the water in the beaker with a thermometer. This will be the boiling point of the liquid inside the tube.

So far you have observed the effect of vapor pressure with apparatus that kept the vapor isolated. It is an interesting fact, however, that the vapor of any liquid continues to exert its own characteristic pressure, in unaltered degree, regardless of any other vapor, gas, or gas mixture, such as air, that may also be present. To show this, fit a glass flask with a two-hole stopper and insert in one hole a bent glass tube with an outlet dipping into a vessel of water. Fill a medicine dropper with gasoline, alcohol, acetone, or some other volatile liquid and insert it in the remaining hole of the stopper. The entire apparatus must be gas-tight. Squeeze a drop or two of the volatile liquid into the flask, and you will see bubbles of air emerge from the tube that dips into water. Since the volume of air displaced is out of all proportion to the minute amount of liquid introduced, additional pressure in the flask due to the vapor pressure of the volatile liquid must have been responsible. The liquid produces a vapor pressure of its own, apart from the pressure of the air already in the flask, and the total pressure in the vessel is the sum of the two.

Molecules of different substances do not have the same average velocity, even at the same temperature. Speedy ones like those of hydrogen, a light gas, travel at the staggering speed of a mile a second, or faster than a rifle bullet, at room temperature. Molecules of heavier gases or gas mixtures move slower. Though it would not be possible for you to time the motion of an individual molecule, you can readily compare the average speeds of different kinds of molecules in your home laboratory. The simple apparatus employed will also enable you to determine the specific gravity of a gas, or its density compared with air.

THIS set-up, known as Schilling's apparatus, provides a glass tube that may be filled with gas, and a smaller tube, with a tiny orifice at its top, through which the gas can escape. A diagram accompanying this article shows the construction of the apparatus. To make the orifice tube, hold a short length of glass tubing in the flame of a Bunsen burner until its bore is almost, but not quite, closed. Then connect it with rubber tubing to a glass T tube. The opposite branch of the T tube passes through a cork into a glass tube of half-inch diameter, a foot or so long, which is supported upright in a tall glass vessel. A half-gallon preserve jar, a tall, *(Continued on page 120)*

EASY EXPERIMENTS SHOW MOLECULES IN ACTION

(Continued from page 119)

transparent flower jar, or any other convenient receptacle can be pressed into service. Two markers should be placed at different levels on the glass tube, by twisting wire around it. When the jar is filled with water and the rubber tube, with a screw clamp or pinch clamp, has been attached to the remaining branch of the glass T, the apparatus is ready for service.

With the clamp on the rubber tubing closed, raise the glass tube from the water, allowing it to become filled with air. Then replace it in the vessel. At once, air begins escaping through the hole in the orifice tube and the water level rises correspondingly in the lower tube. Using the second hand of a watch, start timing the experiment when the water level reaches the first or lower marker and note how long it takes to arrive at the upper one. What you are really timing is the escape of the measured quantity of air determined by the bore of the tube and the distance between the markers. This should require from forty to [illegible] seconds. If it is much less, the hole in the orifice tube is too big and should be made smaller. When the apparatus is working properly, record the time observed for the escape of the air.

THE next step is to repeat the experiment with another gas. Open the clamp and allow illuminating gas to flow through the rubber tube and the glass T into the apparatus. Let plenty of time elapse for the illuminating gas to sweep all the air out of the inner tube, then close the clamp. Again, note the time for the water level to rise between the two markers. It will be less than for air. The reason for this is that the molecules of illuminating gas move at a greater average speed than those of air. Hence more of the former, in their random movements, will strike the small hole of the orifice tube and escape through it in a given time.

To find the comparative density of the gases you have used, you can apply the known fact that the density of any gas is inversely proportional to the square of the rate at which it escapes through the orifice tube of an apparatus of this type. Suppose, for example, that you found the air escaped in just sixty seconds and the illuminating gas in fifty seconds. This means that the density of the illuminating gas, compared to air, equals fifty squared (or 2,500) divided by sixty squared (or 3,600). The figure comes out 0.69. This is the specific gravity of the gas you have tested, in other words, the gas is sixty-nine one-hundredths as heavy as air.

PLANES CROSS COUNTRY PILOTED ONLY BY RADIO

FLYING swift bombing planes cross-country with no human hand at the controls is a recent accomplishment of the U. S. Army Air Corps. The pilot takes over the handling of his ship only during the take-off and landing, the major part of the flight being made under radio control. The mechanism that makes the feat possible is a union of two previous developments in aviation. One of these, the Sperry gyropilot, already in wide commercial use, automatically holds an airplane upon a preselected course. The other, the Kruesi radio compass, shows when an airplane is pointed toward any radio station to which the device is tuned. By means of a newly developed "connecting link," the two are coordinated so that a pilot has merely to tune the apparatus to the wave length of a transmitting station situated at his destination. The airplane then turns of its own accord toward the station, and the radio compass resets the robot pilot from time to time to compensate for wind drift.

MAKE-BELIEVE BATTLES TEST OUR WAR MACHINE

(Continued from page 17)

neuvers, an elaborate telephone system installed for the umpires enabled 150 of them, scattered over an area of 100 square miles, to keep each other aware of what was happening in rival camps. Thus an umpire, informed of the aiming of enemy guns, might suddenly plant a red flag with a white center in the ground and inform all the doughboys within 150 yards, "You have been wiped out by artillery fire."

Umpires in airplanes fly over a mimic battlefield, spotting white panels laid out by ground umpires to indicate front lines. Once a day they photograph the front lines from the air, to check the marked maps constantly sent in to the chief umpire. They also spot the movements of the combatant planes. A war plane may bring in a valuable report, only to have an umpire rule that the plane has theoretically been shot down—and a dismayed general has to do without the coveted information.

NOT only must the umpires act as arbiters to decide the winners of engagements. They also have the responsibility of laying out the battlefield, telling the commanders where to start the battles, and whom they are fighting. Then it is up to the commanders to work out the problem as best they can, for later review with the umpires sitting in.

Moreover, the umpires must see that if one army is unexpectedly successful, or meets unforeseen difficulties, it will not upset plans for subsequent war problems. If the tide of battle is going the wrong way, an umpire may have to pull a figurative rabbit out of his hat to get the troops to the place where they are supposed to be by nightfall. If necessary, he may trump up an imaginary hostile force that pushes back the troops or inflicts devastating losses. Rabbits sometimes come out of hats in real wars, too. Of course both real and imaginary factors are taken into account when umpires and high commanding officers get together to review the results.

Maneuvers like those at Pine Camp give the men a taste of fighting under conditions as near to actual warfare as can be produced. They learn to fight, not only as individuals, but as members of companies, regiments, divisions, and field armies. All must work together in perfect harmony—infantry with artillery, air forces with both—while the enemy tries to break up and disorganize such teamwork.

To insure this, their officers not only give orders but explain in detail the reason for each one. Every one of the 36,000 men participating at Pine Camp, from generals down to buck privates, knew just what was going on at any moment.

THE high command learned some things, too. A new experiment was carried out successfully when 5,000 regulars of the First Division, motorized with 525 troop-carrying trucks and twenty-five tractors, covered in three hours a distance that would normally be a two-day march. This mass movement averaged thirty miles an hour and 1,500 men passed a given point in less than six minutes.

How significant Army men consider this "hike on wheels" is shown by the fact that General Douglas MacArthur, former Chief of Staff, announced a five-year plan to augment the Army's motor equipment with 18,000 new vehicles. Another lesson showed an Army weakness, telephone messages in the field often suffered delays that would be costly or fatal in war time. By bringing out such weaknesses in war games, it is possible to correct them in time to bring Army forces into perfect coordination if need should ever arise for their defense of the nation.

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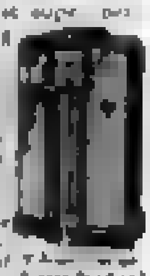

DARING MODERN SPORTSMAN HUNTS WILD BEASTS WITH BOW AND ARROW

(Continued from page 23)

arrow straight home to its intended mark.

While hunting wild turkeys with several Seminole Indians among the pines of Florida recently, Hill demonstrated, with possibly the longest killing shot ever fired from a bow, how he aims, adjusts his fire, and finally kills. Through the branches he saw a horned owl sitting seventy feet up on a dead limb, too far distant for the Indians to reach the bird with their shotguns. The bowman nocked the arrow, aimed twenty feet above the bird at a tassel of pine needles, and loosed his arrow. The missile shot forward and up, descended in an arc, and whizzed between the startled bird's legs. On the second shot, Hill aimed six inches higher. This arrow zipped over the owl's head. For the third, he lowered his aim three inches and sent the arrow directly through the heart, the bird dropping dead to the ground. When he measured the distance, he found the arrows had traveled 146 yards—with deadly accuracy.

HILL uses the end of an arrow like the peep sight of a rifle. He draws halfway between the low draw of a target archer and his eye. At fifty yards, he shoots point-blank. Beyond that distance, he elevates his bow and really aims either at a fixed or an imaginary point upward and slightly to the right of his quarry. He keeps both eyes fixed on the game, and when, out of the corner of his eyes, he sees the arrow come in line with his "aiming point," he lets fly.

Once he rode out onto the Mohave Desert near California's famous Death Valley, commissioned to kill such wild jackasses as he might find. These descendants of sixteenth-century Spanish donkeys bully the desert wild horses, ... and mountain ... Twice as fast as mustangs, they kill coyotes with a single kick of their flying heels. They hog the water holes, biting, trampling, and driving cattle away to die of thirst. Weighing 800 pounds, these wild jacks are real marauders of the desert. They are, in Hill's opinion, the "toughest animals to kill" he has ever faced.

He stalked a band of five surrounding a water hole early one recent morning, creeping up within sixty yards through the mesquite before one noticed him. Quickly nocking an arrow, Hill let fly, striking the biggest jack high in the back. Enraged, the animal wheeled to face the hunter and jumped three times toward him. Coolly, Hill drove a second arrow behind the right ear, and a third into the left flank as the animal spun around. Beaten for the first time in his life, the wild jack wheeled back with the herd, trotted 100 yards and dropped dead.

This expert has killed too many birds and beasts with clean shots for his uncanny skill to be called luck. He bagged an elk in Wyoming at 135 yards with a single arrow. After missing a Rocky Mountain rattler at twenty-five feet, he put the second arrow through the reptile's neck. Again, in Florida, he shot an arrow through another rattler at twenty feet. On several occasions he has killed birds on the wing, sending arrows through their bodies as they sped through the air.

PERHAPS no experience brought him more thrills and chills than one which took place on Santa Cruz Island, off the California coast. Hill had gone there to hunt wild boar. For 300 years this wild band has developed until today, with their long noses, short ears, and long hair, these six-foot hogs resemble grizzly bears when seen from a distance. Curved tusks, sometimes reaching seven inches in length, jut from the lower jaws of the males. Afraid of no living thing, these boars will attack without provocation. More than one careless hunter has met his death by underrating the ferocity of these beasts.

Hill came face to face with a 300-pound boar shortly after setting out along the trail early one morning. Knowing that retreat would invite attack, he stepped forward one pace, at the same time drawing his bow. At that instant, the boar turned broadside. The turkey feathers tipping the arrow, soaked by the fine rain then falling, gave off a fine mist as the missile leaped forward and disappeared in the animal's chest cavity. As a second arrow grazed its rump, the boar charged. By some mischance, Hill had only one arrow left. Knowing this was his last opportunity, he held his fire, ready to send a final, killing shot into the head when the infuriated animal reached the fifteen-foot deadline he had mentally set. But the boar wavered after running twenty yards, slowed, and crumpled in death twenty-five feet from the point where Hill stood ready to leap from the trail in case he missed with the one remaining arrow.

CLOSE as was this call, it hardly compares with his experience near Thermopolis, Wyo., when he rode into the midst of a buffalo herd seeking a fine bull whose hide he wanted. There was no rifle within five miles to protect him in case the wiry Indian pony unseated him while dodging the battering-ram rushes of lowered heads.

Hill found the herd on a small flat, hemmed in on two sides by low hills. Riding to the nearest hill he strung his bow and nocked an arrow. At that moment, a 2,000-pound bull saw him—and charged. Instead of retreating, Hill kicked his pony toward his intended victim, drew his arrow, and loosed it. The stricken buffalo changed from a short gallop to long, bucking leaps. As Hill stopped the bronco to nock a second arrow, a second buffalo charged. Hill saved himself by grabbing the pony's mane with his powerful right hand, dodged a second rush, and, on looking around for his first target, saw the young male lying dead. Able now to give all his attention to the charging monarch of the herd, he fired a dozen shots as rapidly as he could draw and loose the blunt-headed arrows, peppering the buffalo on head and loin until, after only a few seconds, the big animal galloped away, uninjured but thoroughly beaten.

The most difficult game to stalk with bow and arrow, in Hill's opinion, is wild turkey. He found a flock on a California ranch, but was unable to come within shooting distance. So he decided to wait them out. Twice daily for three days, at eleven in the morning and four in the afternoon, he hid himself in brush near a water hole. Finally he got in a single shot at a gobbler. The arrow flew straight to its mark, and the surprised bird walked a hundred yards into near-by undergrowth and dropped.

SHOOTING into the water, which, because of the refraction of light, requires a special aiming technique, this skilled archer has killed alligators, water moccasins, bass, snook, needle-fish, bream, mullet, and alligator gar as well as sharks and sting rays. When shooting fish, Hill uses a special arrow attached by a line to his belt. This arrow is fitted with a single lily iron, which swivels out at one end from the ferrule at the base of the arrow point. The line is tied with piano wire through a hole in the middle of the lily iron, which turns crosswise when a tug of war commences.

In twenty minutes he has bagged twelve gar, one bass, one bream, and two water moccasins while standing on a bridge across a Florida canal. One of these snakes he cut in two at a distance of thirty feet. Another time, he killed ninety-two fish and a snake during a two-hour "still" (Continued on page 123)

HUNTING WILD BEASTS WITH BOW AND ARROW

(Continued from page 122)

hunt. With heavy arrows he has killed fish swimming as deep as five feet. By increasing the length of the heavy, stiff-spined arrows from twenty-eight inches to five feet and using needle-sharp bullet-type heads, he believes he can bag finny game twelve feet down, while a bullet from the highest-powered rifle will penetrate effectively only two feet.

Hill stalks all game, whether in the highlands or in the sea, and never exposes himself until he is ready for a killing shot. For instance, while hunting sting rays and sharks among the small keys off Key Largo, Fla., he cut up an eagle ray and dropped a trail of small pieces overboard to lure sharks in toward land, where the water is both shallow and clear. While waiting for sharks, he put out in a small boat and whipped an arrow into a sting ray. Stung by the barb, the creature made off at express speed for deep water, a mile distant. After zipping through the water a short distance, it stopped as suddenly as it had started. Hill pulled in the line until only twenty feet of water separated him from the monster, stood in the prow of the frail craft, and twanged a moose arrow into the sting ray. After he had dispatched a third arrow through the base of its brain, the six-foot, whiplike tail lashed once and the captive died.

BUT alligators! This bowman has seen these lightning-fast creatures dodge arrows when they seemed to be asleep. More than once has he crept up on a 'gator, only to have him slide like an eel at the twang of the bow, and the arrow strike the sand at the spot where the animal had been basking less than a second before.

Hill drove a broadhead through one alligator from a distance of forty yards, only to see him leap into the water, bent on escape. Knowing the habits of the creature from long experience, the archer crossed the canal, stood silently nearly a half-hour observing the bubbles as they rose through the murky water, and then drew half back, ready to loose an arrow when the 'gator's nose appeared. Hardly had he raised the bow when the gray nose broke the surface. Hill aimed eighteen inches below it, and fired. The alligator ducked, but too late, and the wicked head ploughed through his leather hide, carrying the shaft in to the feathers. For a full hour the doomed animal thrashed, then disappeared. Next day he was found, dead.

This modern William Tell believes he can kill any animal with bow and arrow. Having taken the fiercest and largest in North America with 110-pound bows, he hopes to prove his skill on elephants, hippopotamuses and rhinoceroses. He has secretly designed a bow and arrows of great penetrating power which he thinks will turn the trick. In a test he shot one of these arrows through nine truck tires.

FOR five years Hill held the world's flight record of 410 yards. To achieve that record his powerful muscles pulled a 172-pound bow, strongest ever used. He introduced shorter arrows and bows for distance shooting and was first to use longer feathers on hunting arrows to make them fly truer. His white birch hunting arrows leave his powerful bow at a speed of 300 feet a second and bore through the air, turning once for each ten feet of flight. He fits his bows with linen thread, so strong it will withstand a pull of 600 pounds.

He fashions all his arrows, sandpapering and shellacking the shafts until they are as smooth as owl grease. His concave heads, while lacking the stunning power of a lead bullet, possess the penetrating power of a .30/06 steel-jacketed bullet. The shaft measures three-eighths of an inch in diameter and, with the steel-saw head, weighs 800 grains.

HERE'S THE ANSWER

(Continued from page 57)

iron ore do cause poor radio reception. However, regardless of locality, radio transmission is usually better at night than during the day. The reason for this, it is believed, is the ionization of the air by the sunlight, that is, the light breaks down the molecules of air into tiny particles which are electrically charged. The effect of these ionized particles or ions is to absorb some of the energy of the radio waves and thus reduce the volume received by the radio set.

One Squid That Flares Up

Q.—DO ALL squids protect themselves by sending forth an inky black substance? I have heard otherwise.—W. C., Bridgeport, Conn.

A.—THE heteroteuthis, a squid found along the Italian coast, throws out a luminous secretion which envelopes it in a cloud of "fire." The luminosity is effective for quite a time.

Drawing Hair Lines

Q.—ALL mammals are supposed to have hair. Does a whale?—H. H. E., Oklahoma City, Okla.

A.—WHALES are the only exception to this rule but, in fact, they are only a partial exception. Many species of whales have a very limited number of hairs in the region of the jaw. The others which show no signs of hair are known to possess hair in the fetal stage. The white whale and the narwhal are devoid of hair.

Excavating on a Big Scale

W. A. H., CEDAR RAPIDS, IOWA. Meteor Crater in Arizona is four fifths of a mile in diameter and nearly 600 feet deep. It is estimated that more than 300,000,000 tons of rock were dislodged when a meteor mass, weighing as much as 10,000,000 tons, struck the earth at this spot. Scientists have calculated that the meteorite was probably traveling at the rate of seven to forty miles a second.

And It's Not a Pig

Q.—IS THE guinea pig a native of the Guinea costal region in Africa, as its name suggests? What is the largest extant member of the rodent family?—R. O. R., Springfield, Mo.

A.—THE guinea pig is a native rodent of South America. The capybara, also a native of South America, is the largest living rodent. It frequently exceeds three feet in length (the tail is insignificant) and 100 pounds in weight.

First Aid for Rubber Boots

Q.—WILL you please let me have a formula for patching rubber boots?—A. D. H., Mobile, Ala.

A.—THE following mixture will not only cement rubber to rubber but will firmly fasten rubber to almost any other substance: Finely chopped India rubber, 100 parts; rosin, fifteen parts; shellac, ten parts; carbon disulphide, a quantity sufficient to dissolve. The latter ingredient is very volatile and inflammable.

All-in-One Ink Remover

Q.—CAN you give me a formula for a single-solution ink eradicator?—F. E. C. Jr., Chicago, Ill.

A.—A SINGLE solution that will answer for most inks is made by mixing equal parts of citric acid and powdered alum, to which is added an equal part of water. By omitting the water, the mixture can be used as a dry eradicator. In the latter case, the powder is spread over the spot and rubbed in well with the fingers. A few drops of water are then added and rubbed in. A rinsing with water completes the process.

Warm Today...Freezing Tomorrow...Warm Today...Freezing Tomorrow

FIND YOUR CAR ON THIS CHART

IMPORTANT! The price per gallon of an anti-freeze means nothing unless you know *how many gallons* you will need during the *entire* winter. You can't get that information on a boil-away anti-freeze. But you can get it for Eveready Prestone...and here it is. See how reasonably you can get two-way protection all winter long against both freeze-up and rust with *one shot* of Eveready Prestone—one shot because it won't boil off, no matter how warm the weather gets between the cold snaps. If your car isn't on this chart, your dealer has a chart showing all cars; and amounts needed for temperatures to 62° below zero.

Find your car and read from left to right. The first figure shows the protection you get with one gallon of Eveready Prestone in the cooling system; the second with one and a half gallons—and so on. "+" means above zero. "−" means below zero. If your car has a hot water heater, add ½ gallon to the quantity called for.

	1 GAL.	1½ GAL.	2 GAL.	2½ GAL.
Auburn				
6-54, '34; 6-54, '35	+12	+4	−27	−59
8-100, '32; 8-101, 8-105, '33	+15	+2	−16	−42
8-98, '30; 650, '34; 851, '35	+17	+6	−9	−26
Buick				
40, '34, '35	+6	−18	−54	
40, '32, 30, '33, '34, '35	+10	−6	−34	−62
80, 90, '32; 80, '33, '34, '35	+15	+2	−16	−42
80, 90, '30, 90, '34, '35	+19	+9	+1	−16
Cadillac				
370-D, '34, '35	+24	Zero	−21	−59
355-D, '34, '35	+16	+4	−16	−34
452-D, '34, '35	+19	+9	+1	−16
370-A, '31; 353-B, '32; 353-C, '33	+21	+13	+3	−9
Chevrolet				
Stand, '34, '35, '35	−12	−42		
Master, '33, '34, '35	+6	−17		
Master, '31, '32	Zero	−10	−62	
Chrysler				
8-, '32, '33, '34, '35	+12	−6	−27	−59
8-, '31, '32, AP, IMP, '29	+15	+2	−16	−42
Roy 8, Imp 8, '31; Air 8, '35	+16	+4	−12	−34
Imp, '30, '77, '30, '30, '31	+16	+6	−6	−25
De Soto				
6, '31, '32, '33; 8, '31	+10	−8	−34	−62
6, '34	+15	+2	−12	−34
Airflow, Airstream, '35	+12	−4	−27	−59
Dodge				
6, '32, '33, '34	+8	−12	−42	
Sen 6, '30, New Six, '35	+13	+4	−29	−59
6-'32, '33	+15	+2	−16	−42
Ford				
A, '30, '31; B, '32, '33	Zero	−34	−62	
V-8, '32, '33, '34	+16	+2	−6	−25
V-8, '35	+16	+6	−12	−34
Graham				
75-Spl 6; 75-8, '35	+14	Zero	−21	−59
6, 8, '33; 6, 8, '34, 75, '35	+16	+4	−12	−34
Hudson				
8, '31, '32, '33; 6, '35	+12	−4	−27	−59
8, '35	+17	+6	−9	−29
8, '34	+19	+9	+1	−16
Hupmobile				
18, '31; Cent 8, '32; 321, '33	+17	−6	−34	−62
417, 421, '34; 521, '35	+10	−8	−34	−62

	1 GAL.	1½ GAL.	2 GAL.	2½ GAL.
Hupmobile Cent'l				
302, '33; 653, '34; 656, '35	+10	+4	−8	−26
325, '33; 426, '34; 527, '35	+19	+19	Zero	−25
La Fayette				
1934; 8516, '35	+13	+2	−16	−42
La Salle				
350, '34, 35-50, '35	+15	+2	−16	−42
345-B, '32; 345-C, '33	+21	+13	+3	−9
Lincoln				
136, '34, '35; 145, '34, '35	+13	+17	+10	−3
Nash				
80, '34; 960, '33, 70, '32; 670, '33	+3	−25	−62	
1130, 1670, 1170, '34; 1220, '34	+12	−4	−27	−59
1290, '35; 1060, '35; 1080, 1280, '35	+17	+6	−9	−25
Oldsmobile				
F-30, '30; F-33, '31; F-33, '35	+3	−25	−62	
F-33, L-33, '30; F-34, '32, L-34	+13	−6	−27	−59
L-33, '31; L-34, '35	+15	+2	−16	−42
Packard				
200-'35	+12	−6	−27	−59
Sup 8, '34, '35; 6, '33, '34, '35	+16	+6	−12	−34
Sup 6, '35	+17	+8	−6	−25
745, '30; 845, '31; Dot, '32	+20	+13	+3	−9
Pierce Arrow				
81, 42, 43, '31, '34, '35; 836-A, '34	+13	+13	+3	−9
840-A, '34; 845, '35	+19	+13	+6	−3
Plymouth				
30, '30, 30, 30, '34	+2	−14	−34	
PA, '34; PB, '35; PS, '34; P2, '35	+10	−6	−34	−62
PC, PD, '32	+3	−25	−62	
Pontiac				
'30, '31; 6-'32, '33	+8	−14	−34	
8-'33, '34, '35	+8	−12	−42	
Reo				
A-25, 6-25, '32, 30, '33, Roy, '35	+15	+2	−16	−42
B-25, '32; 6-5, '33; 6-6, '34	+19	+6	−12	−34
Studebaker				
Com 6, '34, '35; '32, Dict 8, '34, '35	+10	−6	−34	−62
Dict '33, Com 8, '34, Pres 8, '33, '34	+14	Zero	−21	−50
Pres 8, '35, '35, '35, Com 8, '35	+17	+6	−9	−29
Terraplane				
8, '34, '35; 6-Spec, '35	+3	−25	−62	
8, '33, 6 Del., '33	+10	−8	−34	−62
8, '34	+14	Zero	−20	−50

PRICE REDUCED AGAIN

Eveready Prestone was used by a million more motorists last winter than the winter before. Thanks to by far the biggest volume in its history, the price has been reduced again to only $2.70 a gallon.

$2.70 a GALLON

Put in EVEREADY PRESTONE

the GUARANTEED* ANTI-FREEZE

One shot, put in now, will guard your car against freeze-up and rust all winter. Eveready Prestone won't boil off no matter how warm the weather gets between the cold snaps. Has no odor. Specifically guaranteed.

ASK YOUR DEALER THIS ONE QUESTION

Of more than 100 brands of anti-freeze on the market, most are based on alcohol—but are not plainly labeled as such. So ask your dealer this question about any anti-freeze you consider buying: "*How much* of this product is alcohol?" That is important, for alcohol, no matter how disguised or what it is called, is subject to evaporation, leaving you without adequate protection.

Your dealer will tell you that Eveready Prestone contains no glycerine, no alcohol...and *that it will not* boil off or evaporate. Back of every drop of Eveready Prestone is the following guarantee...your definite assurance of *all-winter* protection.

*A DEFINITE GUARANTEE

"National Carbon Company, Inc., specifically guarantees that Eveready Prestone, if used according to printed directions, in normal water cooling systems, will protect the cooling system of your car against freezing and clogging from rust formations for a full winter, also that it will not boil away, will not cause damage to car finish, or to the metal or rubber parts of the cooling system, and that it will not leak out of a cooling system tight enough to hold water."

SPECIAL OFFER... A "Weather Wheel" which will help you to forecast the weather. Also "Weather as a Hobby"—a 32-page illustrated book, prepared by weather experts. Full of fascinating weather facts. Send for them (stamps or coin) to National Carbon Co., Inc., Box 600, Grand Central Station, New York, N. Y.

Name_____

Address_____

_____ (P.S.M. 12)

UCC

Trade Mark Union Carbide and Carbon Corporation

Welding

. . . the best way to make a perfect union of two pieces of metal is by welding them together.

. . . and the best way to make a good cigarette is to WELD together the right quantity of different types of mild, ripe tobaccos

. . . that is just what we do in making Chesterfield Cigarettes. The three types of home-grown tobaccos (Bright, Burley and Maryland) are welded together. That is, the qualities of each of the three kinds are made into one kind.

Then these three tobaccos which have been welded together are welded with aromatic Turkish tobacco.

Mixing tobaccos is one thing; blending is another thing—but in order to get the best flavor and aroma, the tobaccos should be welded together.

Chesterfield ... *the cigarette that's MILDER*

Chesterfield ... *the cigarette that TASTES BETTER*